



United States  
Department of  
Agriculture



Natural  
Resources  
Conservation  
Service

In cooperation with  
Kansas Agricultural  
Experiment Station

# Soil Survey of Geary County, Kansas





# How to Use This Soil Survey

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## General Soil Map

The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

## Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet and turn to that sheet.

Locate your area of interest on the map sheet. Note the map units symbols that are in that area. Turn to the **Contents**, which lists the map units by symbol and name and shows the page where each map unit is described.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

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This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (formerly the Soil Conservation Service) has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in the period 1987 to 1991. Soil names and descriptions were approved in 1991. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1991. This survey was made cooperatively by the Natural Resources Conservation Service and the Kansas Agricultural Experiment Station. It is part of the technical assistance furnished to the Geary County Conservation District.

Soil maps in this survey area may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

All programs and services of the Natural Resources Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

**Cover:** Typical area of the Benfield-Florence-Konza association. Benfield and Florence soils are on the steep, rocky slopes in the background. The less sloping Tully soils are in the foreground.

*Additional information about the Nation's natural resources is available on the Natural Resources Conservation Service home page on the World Wide Web. The address is <http://www.nrcs.usda.gov> (click on "Technical Resources").*

# Contents

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<b>Cover</b> .....	1	Pt—Pits, quarries .....	38
<b>How to Use This Soil Survey</b> .....	3	Ra—Reading silt loam, 0 to 1 percent slopes .....	38
<b>Foreword</b> .....	7	Re—Reading silty clay loam, 0 to 2 percent slopes ..	39
General Nature of the County .....	9	Sa—Sarpy loamy fine sand, 0 to 4 percent slopes, occasionally flooded .....	39
How This Survey Was Made .....	10	Sc—Sarpy gravelly loamy sand, 0 to 4 percent slopes, occasionally flooded .....	39
Map Unit Composition .....	11	Sh—Solomon silty clay, occasionally flooded .....	40
<b>General Soil Map Units</b> .....	13	St—Sutphen silty clay, occasionally flooded .....	40
Soil Descriptions .....	13	Tn—Tully silty clay loam, 1 to 4 percent slopes .....	41
<b>Detailed Soil Map Units</b> .....	21	To—Tully silty clay loam, 3 to 8 percent slopes .....	42
Be—Benfield-Florence complex, 5 to 30 percent slopes .....	21	Vc—Valentine loamy fine sand, 5 to 15 percent slopes .....	43
Cc—Clime silty clay loam, 20 to 40 percent slopes, stony .....	22	We—Wells-Ortello complex, 1 to 4 percent slopes ...	44
Cf—Clime-Sogn silty clay loams, 5 to 20 percent slopes .....	23	Wf—Wells-Ortello complex, 4 to 8 percent slopes ....	44
Cr—Crete silty clay loam, 0 to 1 percent slopes .....	24	Prime Farmland .....	45
Cs—Crete silty clay loam, 1 to 4 percent slopes .....	24	<b>Use and Management of the Soils</b> .....	47
Ct—Crete silty clay loam, 3 to 8 percent slopes .....	26	Crops and Pasture .....	47
Eu—Eudora silt loam, occasionally flooded .....	26	Rangeland .....	49
Ge—Geary silt loam, 3 to 8 percent slopes .....	27	Native Woodland, Windbreaks, and Environmental Plantings .....	54
Gf—Geary silt loam, 7 to 15 percent slopes .....	27	Recreation .....	55
He—Haynie silt loam, frequently flooded .....	28	Wildlife Habitat .....	57
Hf—Hobbs silt loam, channeled .....	28	Engineering .....	58
Hg—Hobbs silt loam, occasionally flooded .....	29	<b>Soil Properties</b> .....	63
Hm—Holder silt loam, 1 to 3 percent slopes .....	30	Engineering Index Properties .....	63
Ho—Holder silt loam, 3 to 7 percent slopes .....	30	Physical and Chemical Properties .....	64
Id—Irwin silty clay loam, 3 to 7 percent slopes .....	31	Soil and Water Features .....	65
Ka—Kahola silt loam, channeled .....	31	<b>Classification of the Soils</b> .....	69
Kb—Kahola silt loam, occasionally flooded .....	32	Soil Series and Their Morphology .....	69
Ko—Konza silty clay loam, 1 to 3 percent slopes .....	33	Benfield Series .....	69
Lm—Ladysmith silty clay loam, 0 to 2 percent slopes	34	Clime Series .....	70
Lo—Longford loam, 1 to 3 percent slopes .....	35	Crete Series .....	71
Mb—McCook silt loam, occasionally flooded .....	35	Eudora Series .....	72
Mc—McCook silt loam, rarely flooded .....	36	Florence Series .....	73
Mk—McCook-Smokyhill silt loams, occasionally flooded .....	36	Geary Series .....	73
Mu—Muir silt loam, rarely flooded .....	37	Haynie Series .....	74
M-W—Miscellaneous water areas .....	38	Hobbs Series .....	74
Oc—Orthents .....	38	Holder Series .....	74
Or—Orthents, earthen dam .....	38	Irwin Series .....	75

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Kahola Series .....	76	Table 2.--Freeze Dates in Spring and Fall .....	97
Konza Series .....	76	Table 3.--Growing Season .....	97
Ladysmith Series .....	77	Table 4.--Acreage and Proportionate Extent of the	
Longford Series .....	78	Soils .....	98
McCook Series .....	79	Table 5.--Prime Farmland .....	99
Muir Series .....	79	Table 6.--Land Capability and Yields Per Acre of	
Ortello Series .....	80	Crops and Pasture .....	100
Reading Series .....	80	Table 7.--Rangeland Productivity .....	102
Sarpy Series .....	80	Table 8.--Windbreaks and Environmental Plantings .....	104
Smokyhill Series .....	81	Table 9.--Recreational Development .....	108
Sogn Series .....	81	Table 10.--Wildlife Habitat .....	111
Solomon Series .....	81	Table 11.--Building Site Development .....	114
Sutphen Series .....	82	Table 12.--Sanitary Facilities .....	117
Tully Series .....	83	Table 13.--Construction Materials .....	120
Valentine Series .....	83	Table 14.--Water Management .....	123
Wells Series .....	84	Table 15.--Engineering Index Properties .....	126
<b>References</b> .....	85	Table 16.--Physical and Chemical Properties of the	
<b>Glossary</b> .....	87	Soils .....	131
<b>Tables</b> .....	95	Table 17.--Soil and Water Features .....	134
Table 1.--Temperature and Precipitation .....	96	Table 18.--Classification of the Soils .....	136

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# Foreword

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This soil survey contains information that can be used in land-planning programs in Geary County, Kansas. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

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# Soil Survey of Geary County, Kansas

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United States Department of Agriculture, Natural  
Resources Conservation Service,  
in cooperation with  
Kansas Agricultural Experiment Station

## General Nature of the County

GEARY COUNTY is in the east-central part of Kansas (fig. 1). It has a total area of 258,611 acres, or 404 square miles.

Most of the county is in the Bluestem Hills major land resource area (3). The northwest corner of the county is in the Central Loess Plains major land resource area. The soils in the Bluestem Hills are dissected by entrenched drainageways. They are shallow to deep, are gently sloping to steep, and have a clayey or loamy subsoil. The soils of the Central Loess Plains are generally deep, are nearly level to moderately sloping, and have a clayey or silty subsoil.

The county is drained by the Kansas River which is formed by the junction of the Smoky Hill and Republican Rivers at Junction City. The southern part of the county is drained by many deeply entrenched small streams that flow in a northwest direction and empty into the Smoky Hill or Kansas Rivers.

About 44 percent of the county is range, 35 percent is cropland, and the rest is woodland, urban, industrial land, or water areas (9).

This survey updates the soil survey of Geary County, Kansas, published in 1960 (4) and the survey of Riley County, Kansas, and part of Geary County, Kansas, published in 1975 (5). It provides additional information and improved soil interpretations.

## Climate

Table 1 gives data on temperature and precipitation for the survey area as recorded at Milford, Kansas, in the period 1965 to 1987. Table 2 shows probable dates

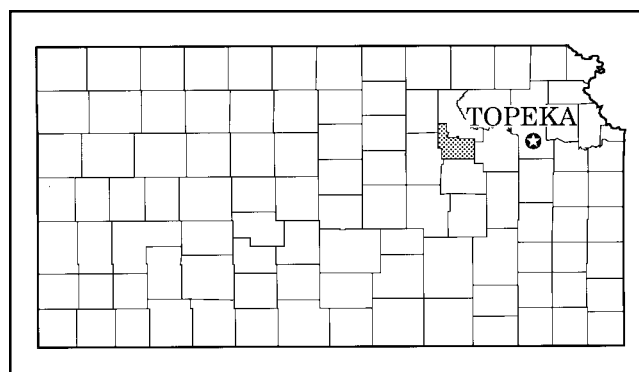


Figure 1.—Location of Geary County in Kansas.

of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter, the average temperature is 29 degrees F and the average daily minimum temperature is 18 degrees. The lowest temperature on record, which occurred at Milford on February 1, 1979, is -18 degrees. In summer, the average temperature is 76 degrees and the average daily maximum temperature is 88 degrees. The highest recorded temperature, which occurred at Milford on July 15, 1980, is 110 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is about 32 inches. Of

this, 23 inches, or about 70 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 18 inches. The heaviest 1-day rainfall during the period of record was 4.78 inches at Milford on June 18, 1977. Thunderstorms occur on about 57 days each year.

The average seasonal snowfall is about 16 inches. The greatest snow depth at any one time during the period of record was 15 inches. On the average, 27 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The sun shines 65 percent of the time possible in summer and 55 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 12 miles per hour, in the spring.

## How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however,

soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain

depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

## **Map Unit Composition**

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by two or three kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to

other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.



# General Soil Map Units

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The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The descriptions and names of the soils identified on the general soil map of this county do not fully agree with those of the soils on the maps of adjacent counties. Differences result from modifications in series concepts, a higher or lower intensity of mapping, or variations in the extent of the soils in the counties.

## Soil Descriptions

### 1. Konza-Irwin-Ladysmith Association

*Very deep, nearly level to moderately sloping, moderately well drained and somewhat poorly drained soils that have a clayey subsoil; on uplands*

This association is on an undulating and gently rolling dissected plain that is underlain by limestone and shale. A thin mantle of loess covers most of the area. The valley slopes have many short drainageways cut into the side slopes. The drainageways join and become creeks that flow in winding courses through narrow flood plains. Relief from the valley floors to the ridge crests ranges from about 50 to 180 feet. Slopes range from 1 to 7 percent.

This association makes up about 14 percent of the county. It is about 38 percent Konza soils, 35 percent

Irwin soils, 14 percent Ladysmith soils, and 13 percent minor soils (fig. 2).

The gently sloping, moderately well drained Konza soils formed in loess over a paleosol. They are on narrow ridgetops and shoulder slopes. Typically, the surface layer is very dark gray silty clay loam about 6 inches thick. The subsoil is about 44 inches thick. In sequence downward, it is dark grayish brown, very firm silty clay; brown, firm silty clay; mixed brown and grayish brown, firm silty clay loam; and mixed grayish brown and light brownish gray silty clay loam. The substratum to a depth of 80 inches is brown and dark brown. The upper part is silty clay loam, and the lower part is silty clay.

The moderately sloping, moderately well drained Irwin soils formed in clayey sediments over residuum derived from limestone. They are on side slopes. Typically, the surface layer is very dark gray silty clay loam about 6 inches thick. The subsurface layer is very dark grayish brown silty clay loam about 7 inches thick. The subsoil to a depth of 60 inches is very firm. In sequence downward, it is dark grayish brown clay, brown clay, brown silty clay, brown silty clay loam, and mixed dark brown and brown silty clay loam.

The nearly level, somewhat poorly drained Ladysmith soils formed in clayey sediments on broad ridgetops. Typically, the surface layer is dark gray silty clay loam about 7 inches thick. The subsoil is about 31 inches thick. It is very firm. The upper part is dark gray silty clay; the next part is dark gray, mottled clay; and the lower part is pale brown, mottled clay. The substratum to a depth of about 60 inches is pale brown and very pale brown, mottled silty clay.

The minor soils in this association are Benfield, Clime, Florence, Kahola, and Tully soils. The moderately deep Benfield and Clime soils are on moderately sloping to steep side slopes. The deep, cherty Florence soils are on moderately sloping shoulder slopes and strongly sloping upper side slopes. The very deep Kahola soils are on flood plains. The very deep Tully soils are on foot slopes and the lower side slopes.

Most of the acreage in this association is used for cultivated crops. The rest is mainly range. Wheat, grain

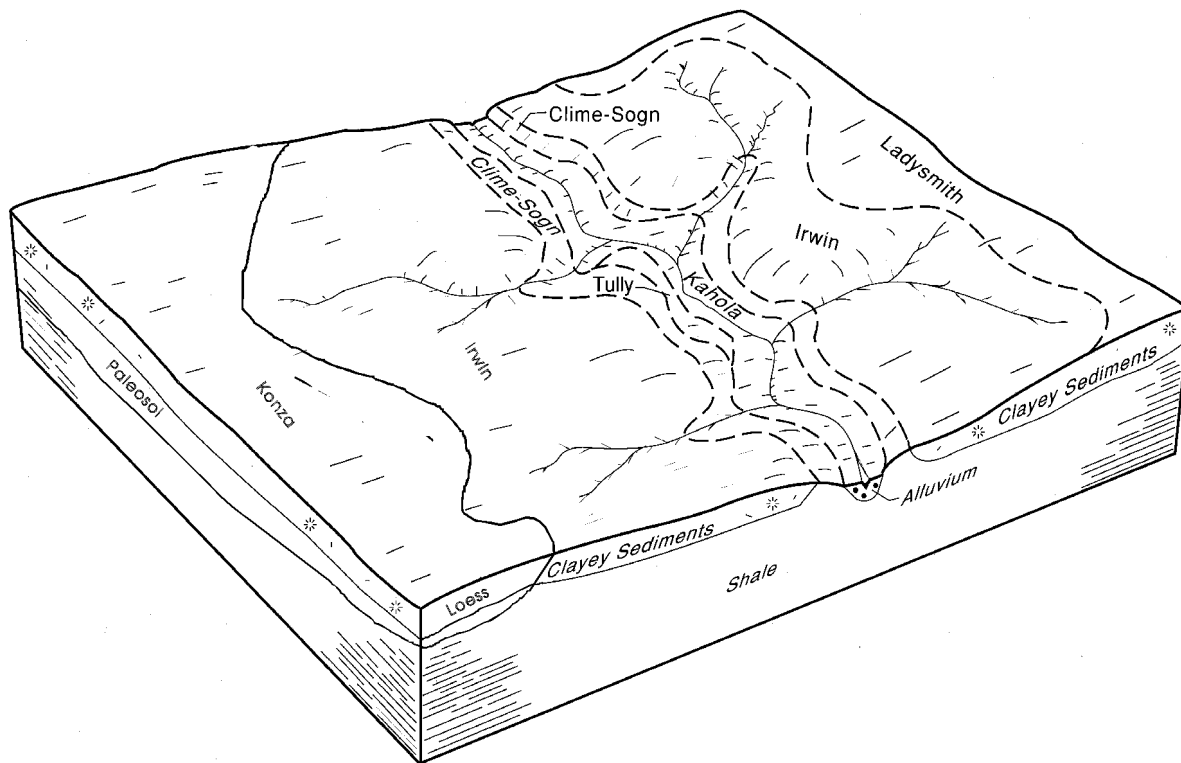


Figure 2 - Typical pattern of soils and underlying material in the Konza-Irwin-Ladysmith association.

sorghum, soybeans, and alfalfa are the main crops. Controlling erosion, conserving moisture, and maintaining good tilth and fertility are the main concerns in managing cropland.

## 2. Benfield-Florence-Konza Association

*Very deep, deep, and moderately deep, gently sloping to steep, well drained and moderately well drained soils that have a clayey or very cobbly and clayey subsoil; on uplands*

This association is on deeply dissected cherty limestone and shale uplands with narrow divides and steep-sided valleys. Most of the perennial streams flow in a northwesterly direction and have narrow bottom lands. Local relief in the uplands is 10 to 40 feet, but the relief from valley floors to ridge crests ranges from about 100 to 200 feet. Slopes range from 1 to 30 percent.

This association makes up about 23 percent of the county. It is about 35 percent Benfield soils, 28 percent Florence soils, 10 percent Konza soils, and 27 percent minor soils.

The moderately deep, well drained Benfield soils formed in colluvium over residuum weathered from clayey, calcareous shale. They are on moderately

sloping to steep side slopes. Typically, the surface layer is very dark gray silty clay loam about 5 inches thick. The subsurface layer is very dark grayish brown silty clay loam about 5 inches thick. The subsoil is about 28 inches thick. The upper part is dark reddish gray, firm gravelly silty clay; the next part is reddish brown, very firm silty clay; and the lower part is olive gray, extremely firm silty clay. Shale bedrock is at a depth of about 38 inches.

The deep, well drained Florence soils formed in material weathered from cherty limestone. They are on summits and shoulder slopes above the Benfield soils. Typically, the surface layer is very dark grayish brown gravelly silt loam about 5 inches thick. The subsurface layer is brown very gravelly silty clay loam about 9 inches thick. The subsoil is about 42 inches thick. The upper part is reddish brown, mottled, very firm very cobbly clay; the next part is dark reddish brown, mottled, very firm very cobbly clay; and the lower part is reddish brown, mottled, calcareous, firm very cobbly silty clay. Cherty limestone bedrock is at a depth of about 56 inches.

The very deep, gently sloping, moderately well drained Konza soils formed in loess over a paleosol. They are on ridgetops and shoulder slopes. Typically,

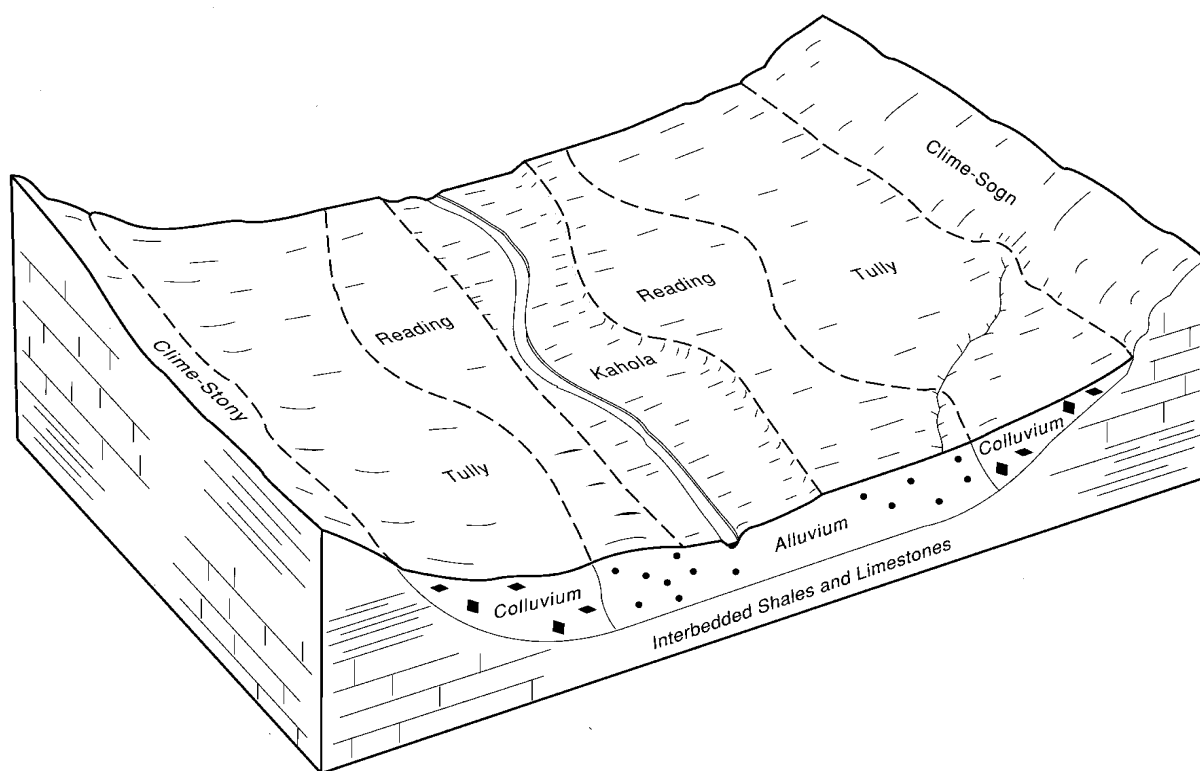


Figure 3.—Typical pattern of soils and underlying material in the Tully-Reading-Kahola association.

the surface layer is very dark gray silty clay loam about 6 inches thick. The subsoil is about 44 inches thick. In sequence downward, it is dark grayish brown, very firm silty clay; brown, firm silty clay; mixed brown and grayish brown, firm silty clay loam; and mixed grayish brown and light brownish gray silty clay loam. The substratum to a depth of 80 inches is brown and dark brown. The upper part is silty clay loam, and the lower part is silty clay.

The minor soils in this association are Clime, Kahola, Sogn, and Tully soils. The moderately deep Clime soils are on sloping to steep side slopes. The very deep Kahola soils are on flood plains. The shallow, somewhat excessively drained Sogn soils are on strongly sloping side slopes. The very deep, well drained Tully soils are on foot slopes.

This association is used mainly for range. Some areas on foot slopes and ridgetops are used for hay or cultivated crops. Maintaining a vigorous stand of desirable grasses is the main concern in managing the range.

### 3. Tully-Reading-Kahola Association

*Very deep, nearly level to moderately sloping, well drained soils that have a silty or clayey subsoil; on foot slopes and flood plains*

This association is on foot slopes and flood plains along the major streams. These areas are rarely more than 1 mile wide and are flanked by strongly sloping to steep hills. The streams are deeply entrenched and flow in winding courses through the flood plains. The Kahola soils are subject to occasional flooding, and the Reading soils are subject to rare flooding. Local relief is only 10 to 40 feet. Slopes range from 0 to 8 percent.

This association makes up about 5 percent of the county. It is about 35 percent Tully soils, 30 percent Reading soils, 15 percent Kahola soils, and 20 percent minor soils (fig. 3).

The gently sloping and moderately sloping, well drained Tully soils formed in colluvium on foot slopes and the lower side slopes. Typically, the surface layer is very dark grayish brown silty clay loam about 12 inches thick. The subsoil is about 40 inches thick. In sequence downward, it is dark grayish brown, friable silty clay loam; brown, firm silty clay; brown, very firm silty clay; and yellowish brown, firm silty clay.

The nearly level Reading soils formed in silty alluvium on high flood plains that are rarely flooded. Typically, the surface layer is very dark grayish brown silty clay loam about 8 inches thick. The subsurface layer is dark grayish brown silty clay loam about 12 inches thick. The subsoil is firm silty clay loam about

40 inches thick. The upper part is dark grayish brown, and the lower part is yellowish brown and mottled.

The nearly level Kahola soils formed in silty alluvium on flood plains that are occasionally flooded. Typically, the surface layer is very dark grayish brown silt loam about 6 inches thick. The subsurface layer is silt loam about 18 inches. The upper part is very dark grayish brown, and the lower part dark grayish brown. Below this is dark grayish brown, calcareous, very friable silt loam about 20 inches thick. The substratum to a depth of about 60 inches is brown, very friable silt loam. In places the upper half of these soils has thin strata of contrasting color.

The minor soils in this association are Benfield, Clime, Florence, and Sogn soils. The moderately deep Benfield and Clime soils are on strongly sloping to steep side slopes. The deep Florence soils are on summits and shoulder slopes. The shallow, somewhat excessively drained Sogn soils are on strongly sloping side slopes.

Most of the acreage in this association is used for cultivated crops. The rest is mainly range. Wheat, grain sorghum, soybeans, and alfalfa are the main crops. Controlling erosion, conserving moisture, and maintaining good tilth and fertility are the main management concerns.

#### 4. Muir-Eudora Association

*Very deep, nearly level, well drained soils that have a loamy subsoil; on flood plains*

This association is on flood plains along the Republican and Kansas Rivers. These bottom lands are as much as 2 miles wide in places and are flanked by strongly sloping hills. The streams are deeply entrenched and flow in winding courses through the flood plains. The soils are subject to flooding. Local relief is only a few feet. Slopes generally range from 0 to 2 percent but are steeper in areas where a prominent escarpment is between high or low flood plains.

This association makes up about 5 percent of the county. It is about 50 percent Muir soils, 30 percent Eudora soils, and 20 percent minor soils.

The Muir soils formed in silty alluvium on high flood plains that are rarely flooded. Typically, the surface soil is dark gray silt loam about 16 inches thick. The subsoil is dark grayish brown, friable silt loam about 28 inches thick. The substratum to a depth of about 60 inches is brown silt loam. In places the surface layer is loam.

The Eudora soils formed in silty alluvium on flood plains. Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The subsurface layer is silt loam. The upper part is very dark grayish brown, and the lower part is dark grayish brown. The

substratum extends to a depth of about 60 inches. The upper part is pale brown and very pale brown silt loam, the next part is stratified very pale brown and light brownish gray silt loam, and the lower part is very pale brown very fine sandy loam.

The minor soils in this association are Haynie, McCook, Sarpy, Solomon, and Sutphen soils. The frequently flooded Haynie soils are on flood plains adjacent to stream channels. The calcareous McCook soils are on flood plains. The deep sandy and gravelly Sarpy soils are in undulating areas and are on flood plains. The poorly drained Solomon soils are in depressions and oxbows. The moderately well drained Sutphen soils formed in clayey alluvium and are in depressions on flood plains.

This association is used mainly for cultivated crops. Wheat, grain sorghum, soybeans, and alfalfa are the main crops. Maintaining fertility and good tilth is the main management concern.

#### 5. Clime-Sogn-Konza Association

*Very deep, moderately deep, and very shallow, strongly sloping to steep, well drained to somewhat excessively drained soils that have a clayey subsoil; on uplands*

This association is on deeply dissected limestone and shale uplands with narrow ridge divides and steep-sided valleys. Most of the perennial streams flow in a northwesterly direction and have narrow bottom lands. Local relief in the uplands is 10 to 40 feet, but the relief from valley floors to ridge crests ranges from about 100 to 200 feet. Slopes range from 1 to 40 percent.

This association makes up about 27 percent of the county. It is about 55 percent Clime soils, 10 percent Sogn soils, 9 percent Konza soils, and 26 percent minor soils.

The moderately deep, well drained Clime soils formed in residuum weathered from calcareous shale. They are on side slopes. Typically, the surface layer is dark gray, calcareous silty clay loam about 12 inches thick. The subsoil is light gray, calcareous, firm silty clay about 14 inches thick. The substratum is light gray, calcareous silty clay about 4 inches thick. Calcareous, clayey shale bedrock is at a depth of about 30 inches.

The very shallow, somewhat excessively drained Sogn soils formed in residuum weathered from limestone. They are on shoulder slopes and the upper side slopes. Typically, the surface layer is very dark grayish brown silty clay loam about 9 inches thick. Limestone bedrock is at a depth of about 9 inches.

The very deep, moderately well drained Konza soils formed in loess over a paleosol. They are on ridgetops. Typically, the surface layer is very dark gray silty clay loam about 6 inches thick. The subsoil is about 44

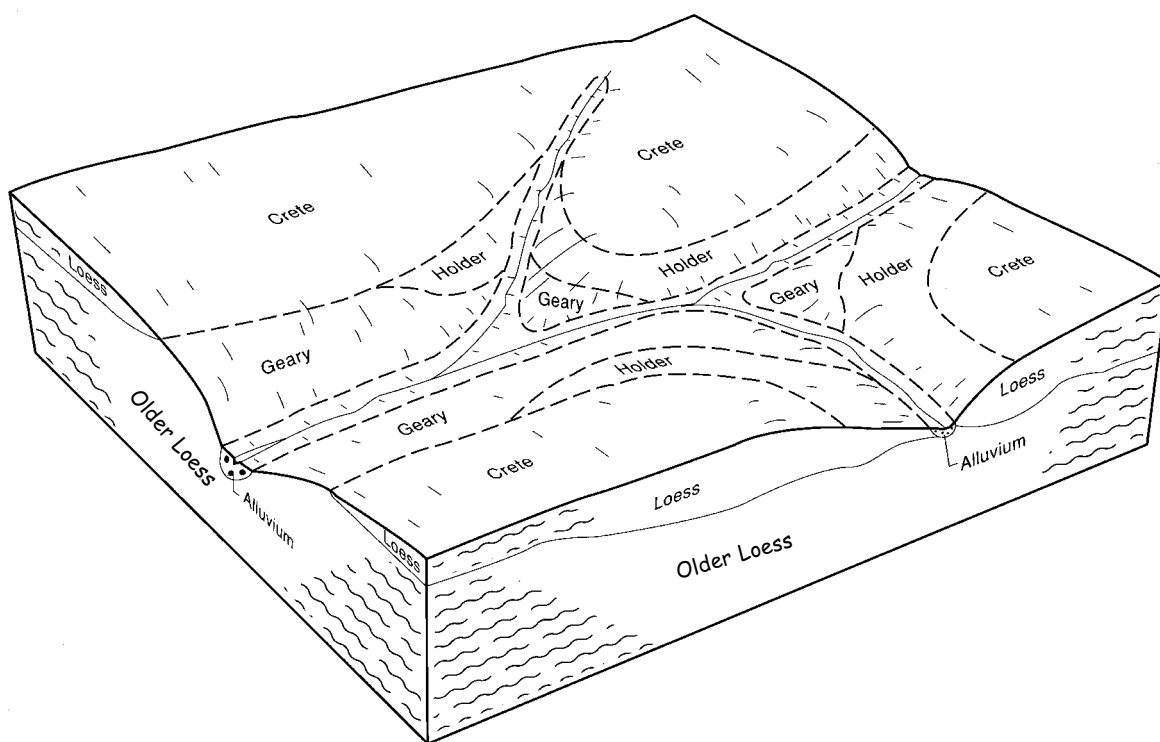


Figure 4—Typical pattern of soils and underlying material in the Crete-Geary-Holder association.

inches thick. In sequence downward, it is dark grayish brown, very firm silty clay; brown, firm silty clay; mixed brown and grayish brown, firm silty clay loam; and mixed grayish brown and light brownish gray silty clay loam. The substratum to a depth of 80 inches is brown and dark brown. The upper part is silty clay loam, and the lower part is silty clay.

The minor soils in this association are Kahola, Reading, and Tully soils. The deep Kahola soils are on flood plains. The deep Reading soils are on high flood plains that are rarely flooded. The deep Tully soils are on foot slopes.

This association is used mainly for range. Some areas on foot slopes or ridgetops are used for hay or cultivated crops. Maintaining a vigorous stand of desirable grasses is the main concern in managing the range.

## 6. Crete-Geary-Holder Association

*Very deep, nearly level to strongly sloping, moderately well drained and well drained soils that have a clayey or silty subsoil; on uplands*

This association is on an undulating to rolling loess-mantled plain. The undulating and gently rolling ridgetops are narrow and winding. The valley slopes

below the ridgetops are gently rolling to rolling. Most of the streams have narrow bottom lands, but a few larger streams have broad, nearly level bottom lands. Relief from valley floors to ridge crests ranges from about 50 to 180 feet. Slopes range from 1 to 15 percent.

This association makes up about 20 percent of the county. It is about 43 percent Crete soils, 15 percent Geary soils, 7 percent Holder soils, and 35 percent minor soils (fig. 4).

The nearly level to moderately sloping, moderately well drained Crete soils formed in loess on ridgetops and side slopes. Typically, the surface layer is dark grayish brown silty clay loam about 6 inches thick. The subsoil is about 57 inches thick. In sequence downward, it is grayish brown, friable silty clay loam; brown, very firm silty clay; brown, very firm silty clay; and pale brown, mottled, firm silty clay loam.

The moderately sloping and strongly sloping, well drained Geary soils formed in loess on sloping side slopes. Typically, the surface layer is very dark grayish brown silt loam about 18 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is dark brown, friable silty clay loam; the next part is brown, firm silty clay loam; and the lower part is strong brown, firm silty clay loam.

The gently sloping and moderately sloping, well

drained Holder soils formed in loess on ridgetops and upper side slopes. Typically, the surface layer is grayish brown silt loam about 14 inches thick. The subsoil is about 44 inches thick and friable. The upper part is brown silty clay loam, the next part is pale brown silty clay loam, and the lower part is very pale brown silt loam. The substratum to a depth of 60 inches is brown silt loam.

The minor soils in this association are Clime, Hobbs, Kahola, and Sogn soils. The moderately deep Clime soils are on strongly sloping side slopes. The very deep Hobbs and Kahola soils are on flood plains that are occasionally flooded. The very shallow Sogn soils are on side slopes.

Most of the acreage in this association is used for cultivated crops. The rest is mainly range. Wheat, grain sorghum, and soybeans are the main crops. Controlling erosion, conserving water, and maintaining good tilth and fertility are the main concerns in managing cropland.

## 7. Wells-Ortello-Longford Association

*Very deep, gently sloping and moderately sloping, well drained soils that have clayey and loamy subsoils; on uplands*

This association is on an undulating and gently rolling plain. A thin mantle of eolian sand covers most of the area. The undulating ridgetops are narrow and winding. The valley slopes below the ridgetops are gently rolling. Most of the streams have narrow bottom lands. Relief from valley floors to ridge crests ranges from about 25 to 125 feet. Slopes range from 1 to 8 percent.

This association makes up about 3 percent of the county. It is about 34 percent Wells soils, 27 percent Ortello soils, 26 percent Longford soils, and 13 percent minor soils.

The gently sloping and moderately sloping, well drained Wells soils formed in alluvium on the lower side slopes. Typically, the surface layer is very dark grayish brown loam about 12 inches thick. The subsoil about 51 inches thick. It is friable. The upper part is dark grayish brown and brown clay loam, the next part is brown sandy clay loam, and the lower part is light brown clay loam.

The gently sloping and moderately sloping, well drained Ortello soils formed in loamy and sandy eolian and alluvial deposits are on ridgetops and side slopes. Typically, the surface layer is very dark grayish brown fine sandy loam about 6 inches thick. The subsurface layer is very dark grayish brown, fine sandy loam about 9 inches thick. The subsoil is about 15 inches thick. It is dark brown, friable fine sandy loam. The substratum

to a depth of about 60 inches is strong brown, friable fine sandy loam.

The gently sloping, well drained Longford soils formed in alluvium on ridgetops and upper side slopes. Typically, the surface soil is dark grayish brown loam about 11 inches thick. The subsoil is about 43 inches thick. The upper part is mixed dark grayish brown and dark brown, firm clay loam, and the lower part is brown, very firm clay loam. The substratum to a depth of about 60 inches is brown loam.

The minor soils in this association are Crete, Hobbs, Kahola, and Valentine soils. The moderately well drained Crete soils are on ridgetops. The well drained Hobbs and Kahola soils are on flood plains. The somewhat excessively drained Valentine soils are on gently rolling and rolling side slopes.

Most of the acreage in this association is used for cultivated crops. The rest is mainly range. Wheat and grain sorghum are the main crops. Controlling water erosion and soil blowing and maintaining good tilth and fertility are the main concerns in managing cropland.

## 8. McCook-Sutphen Association

*Very deep, nearly level, well drained and moderately well drained soils that have a loamy or clayey subsoil; on flood plains*

This association is on flood plains of the Smoky Hill River. These bottom lands are as much as 2 miles wide in some places and are flanked by strongly sloping hills. The streams are deeply entrenched and flow in winding courses through the flood plains. Local relief is only a few feet. Slopes range from 0 to 2 percent but are steeper in areas where there is a prominent escarpment between higher or lower flood plains.

This association makes up about 3 percent of the county. It is about 64 percent McCook soils, 13 percent Sutphen soils, and 23 percent minor soils.

The well drained McCook soils formed in silty alluvium on flood plains. Typically, the surface layer is grayish brown, calcareous silt loam about 8 inches thick. The subsurface layer is grayish brown, calcareous silt loam about 8 inches thick. The next layer is light brownish gray, calcareous silt loam. The substratum to a depth of about 60 inches is calcareous silt loam. The upper part is pale brown, the next part is light brownish gray, and the lower part is mixed grayish brown and light brownish gray. The whole substratum is stratified. These strata vary in thickness and texture.

The moderately well drained Sutphen soils formed in clayey alluvium and are in depressions. Typically, the surface layer is dark gray silty clay about 6 inches thick. The subsurface layer is dark gray silty clay about 15 inches thick. The next layer is dark gray and gray

clay about 9 inches thick. The substratum to a depth of about 60 inches is very firm and mottled. The upper part is grayish brown clay, the next part is light brownish gray silty clay, and the lower part is grayish brown clay.

The minor soils in this association are Haynie, Smokyhill, and Solomon soils. The frequently flooded Haynie soils are on flood plains adjacent to

stream channels. The moderately well drained Smokyhill soils are in depressions. The poorly drained Solomon soils are in depressions and oxbows.

This association is used mainly for cultivated crops. Wheat, grain sorghum, soybeans, and alfalfa are the main crops. Maintaining fertility and good tilth are the main concerns in managing cropland.



# Detailed Soil Map Units

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The map units on the detailed soil maps represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under the heading "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Geary silt loam, 3 to 8 percent slopes, is a phase of the Geary series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Benfield-Florence complex, 5 to 30 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils.

Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

## Be—Benfield-Florence complex, 5 to 30 percent slopes

These well drained, moderately sloping to steep soils are on ridgetops and side slopes that are dissected by many drainageways. The moderately deep Benfield soil is on the more sloping lower side slopes. The deep Florence soil is on shoulder slopes and narrow ridgetops. Many large chert fragments are scattered on the surface. Individual areas are irregular in shape and range from 50 to 1,200 acres in size. The two soils occur as areas so intricately mixed or so small that mapping them separately is impractical.

Typically, the Benfield soil has a surface layer of very dark gray silty clay loam about 5 inches thick. The subsurface layer is very dark grayish brown silty clay loam about 5 inches thick. The subsoil is about 28 inches thick. The upper part is dark reddish gray, firm gravelly silty clay; the next part is reddish brown, very firm silty clay; and the lower part is olive gray, extremely firm silty clay. Shale bedrock is at a depth of about 38 inches. The surface of this soil has chert and limestone fragments that are 3 to 10 inches in diameter and are about 3 to 6 feet apart.

Typically, the Florence soil has a surface layer of dark grayish brown gravelly silt loam about 5 inches thick. The subsurface layer is brown very cobbly silty clay about 9 inches thick. The subsoil is about 42 inches thick. The upper part is reddish brown, mottled, very firm very cobbly clay; the next part is dark reddish brown, mottled, very firm very cobbly clay; and the lower part is reddish brown, mottled, calcareous, firm very cobbly silty clay. Cherty limestone bedrock is at a depth of about 56 inches.

Included with these soils in mapping are small areas of Clime, Irwin, Konza, Kahola, and Tully soils. The moderately deep Clime soils are calcareous throughout and are on side slopes. The deep Irwin and Konza soils do not have coarse fragments in the surface soil. They are on the wider ridgetops. The occasionally flooded Kahola soils are on the bottoms of deeply entrenched drainageways. The deep, well drained Tully soils are on the lower side slopes and foot slopes. Also included, on narrow ridgetops, is a soil that has limestone bedrock at less than 40 inches and has less than 35 percent coarse fragments in the subsoil. Included soils make up about 30 percent of the map unit.

Permeability is slow in the Benfield soil and moderately slow in the Florence soil. Surface runoff is rapid on both soils. Available water capacity is low in both soils. Natural fertility is medium in the Benfield soil and low in the Florence soil. The shrink-swell potential is moderate in the subsoil of both soils. Root penetration is restricted by shale bedrock at a depth of 38 inches in the Benfield soil and by the limestone bedrock at a depth of 56 inches in the Florence soil.

Most areas are used as range. Because the chert fragments interfere with tillage and erosion is a hazard, these soils are generally unsuited to cultivated crops. They are better suited to rangeland.

The native vegetation is dominantly big bluestem, little bluestem, and indiangrass. Overgrazing reduces the extent of the plant cover and causes deterioration of the plant community. Under these conditions, the more productive grasses are replaced by less productive grasses and by weeds, such as tall dropseed, Baldwin ironweed, and western ragweed. Proper stocking rates, a uniform distribution of grazing, timely deferment of grazing, timely burning, and rotation grazing help to keep the range in good condition. Controlled burning in late spring helps to control woody plants and removes old thatch. Well distributed watering and salting facilities and properly located fences improve the distribution of grazing. Suitable sites for stock-water ponds are not readily available. They generally are available in areas of the included Tully soils.

The Florence soil is moderately well suited to dwelling sites. The shrink-swell potential, the slope, and the content of chert fragments are limitations on sites for dwellings without basements. Also, the depth to bedrock is a limitation on sites for dwellings with basements. Using properly designed and reinforced foundations, installing foundation drains, and backfilling with suitable coarse textured material help to prevent the structural damage caused by shrinking and swelling.

The Florence soil is generally unsuitable as a site

for septic tank absorption fields. The restricted permeability is a severe limitation. The slope is a severe limitation on sites for sewage lagoons.

The Benfield soil is poorly suited to dwellings. The shrink-swell potential and the slope are limitations on sites for dwellings with or without basements. Also, the depth to bedrock is a limitation on sites for dwellings with basements.

The Benfield soil is generally unsuited to septic absorption fields. The depth to bedrock and the restricted permeability are severe limitations on sites for sewage lagoons.

The land capability classification is VIe, and the range site is Loamy Upland.

### **Cc—Clime silty clay loam, 20 to 40 percent slopes, stony**

This moderately deep, steep, well drained soil is on breaks and side slopes. Many limestone rocks are scattered over the surface. The rocks are irregular in shape and range from 1 to 3 feet in diameter. They cover less than 3 percent of the surface and are 3 to 40 feet apart. Individual areas are narrow and follow the bluffs of the larger creeks. They range from 50 to 500 acres in size.

Typically, the surface layer is black, calcareous silty clay loam about 9 inches thick. The subsoil is about 18 inches thick. The upper part is very dark gray, calcareous, firm silty clay loam, and the lower part is dark grayish brown, calcareous, very firm silty clay. The substratum is olive gray, calcareous, very firm silty clay loam about 6 inches thick. Calcareous, clayey shale bedrock is at a depth of about 33 inches. In some places the depth to shale bedrock is less than 20 inches.

Included with this soil in mapping are small areas of Kahola, Sogn, and Tully soils and rock outcrop. The deep Kahola soils are on the bottoms of deeply entrenched drainageways. The shallow Sogn soils are in the less sloping areas above the rock outcrop. The deep Tully soils are on foot slopes. The rock outcrop is in narrow bands on the contour. The included soils and rock outcrop make up about 25 percent of the map unit.

Permeability is slow in the Clime soil. Surface runoff is rapid. Available water capacity is low. Natural fertility is medium. The shrink-swell potential is moderate in the subsoil. Root penetration is restricted by the shale bedrock at a depth of 20 to 40 inches.

Nearly all of the acreage is used as range or is wooded. Because of a severe hazard of erosion, the slope, and the many stones on the surface, this soil is



Figure 5.—A spring developed in an area of Clime-Sogn silty clay loams, 5 to 20 percent slopes.

unsuited to cultivated crops and poorly suited to wood production. It is better suited to range.

The native vegetation is dominantly big bluestem, little bluestem, indiangrass, and sideoats grama. Trees and brush have invaded some areas. As a result, brush control is needed to increase forage production. Controlled burning in late spring helps to control woody plants. Properly applied chemical sprays and selective cutting also help to control these plants. Achieving a uniform distribution of grazing is a major management concern. Many areas are grazed infrequently because of the slope and the stones on the surface. Well distributed watering and salting facilities and properly located fences improve the distribution of grazing.

This soil is generally unsuited to building site development because of the slope.

The land capability classification is VIIe, and the range site is Limy Upland.

#### **Cf—Clime-Sogn silty clay loams, 5 to 20 percent slopes**

These moderately sloping to moderately steep soils

are on ridgetops and side slopes that are generally dissected by many drainageways. The moderately deep, well drained Clime soil is on side slopes. The very shallow, somewhat excessively drained Sogn soil is on the ridgetops and shoulder slopes. Individual areas are irregular in shape and range from 10 to 3,000 acres in size. They are about 60 percent Clime soil and 20 percent Sogn soil. These two soils occur as alternating bands that are so narrow that mapping them separately is impractical.

Typically, the Clime soil has a surface layer of dark gray, calcareous silty clay loam about 12 inches thick. The subsoil is light gray, calcareous, firm silty clay about 14 inches thick. The substratum is light gray, calcareous silty clay about 4 inches thick. Calcareous, clayey shale bedrock is at a depth of about 30 inches. In some places, the soil is noncalcareous throughout, and the subsoil is redder. In other places the soil contains some chert or limestone fragments throughout.

Typically, the Sogn soil has a surface layer of very dark gray silty clay loam about 9 inches thick. Limestone bedrock is at a depth of about 9 inches.

Included with these soils in mapping are small areas of Irwin, Kahola, Konza, and Tully soils and limestone rock outcrop. The deep, moderately well drained Irwin and Konza soils are on shoulder slopes and ridgetops above the Clime and Sogn soils. The deep, occasionally flooded Kahola soils are on the flood plains of small included drainageways. The deep Tully soils are on foot slopes and lower side slopes. The limestone rock outcrop is on breaks, in the steeper areas, and on side slopes generally below the Sogn soils. Included soils and outcrops make up about 20 percent of the map unit.

Permeability is slow in the Clime soil and moderate in the Sogn soil. Surface runoff is rapid in both soils. Available water capacity is low in the Clime soil and very low in the Sogn soil. Natural fertility is medium in the Clime soil, and low in the Sogn soil. Organic matter content is moderate in both soils. The shrink-swell potential is moderate in the subsoil of the Clime soil and moderate throughout the Sogn soil. Root penetration is restricted below a depth of 30 inches in the Clime soil and 9 inches in the Sogn soil.

Nearly all of the acreage is used as range although some areas are wooded. Because of the severe erosion hazard of both soils and the shallow depth to limestone in the Sogn soils, this map unit is generally unsuited to cultivated crops. It is better suited to range. The native vegetation is dominantly big bluestem, little bluestem, and sideoats grama. Sideoats grama is more common on the shallow Sogn soil than on the Clime soil. Overgrazing reduces the extent of the plant cover and causes deterioration of the plant community. Under these conditions the taller grasses are replaced by less productive grasses and less desirable forbs and grasses such as blue grama, annual grasses, western ragweed, aromatic sumac, and broomweed. Proper stocking rates, timely deferment of grazing, and uniform distribution of grazing help keep the range in good condition. Trees and brush have invaded in some areas. As a result, brush control is needed to improve the forage production. Controlled burning in the late spring helps to control woody plants. The proper use of chemical sprays and selective cutting also help to control these plants. Well distributed watering and salting facilities and properly located fences improve the distribution of grazing. Suitable sites for stock-water ponds are not readily available. A few areas have potential for spring developments as a source of water (fig. 5).

Because of the depth to bedrock, the restricted permeability, and the slope, the Clime soil is poorly suited to septic tank absorption fields. It is poorly suited to sewage lagoons because of the slope and the depth to bedrock.

The Sogn soil is generally unsuited to building site development because of the shallow depth to bedrock and the slope.

The land capability classification for the map unit is VIe. The range site for the Clime soil is Limy Upland, and the range site for the Sogn soil is Shallow Limy.

### **Cr—Crete silty clay loam, 0 to 1 percent slopes**

This very deep, nearly level, moderately well drained soil is on ridgetops. Individual areas are irregular in shape and range from 20 to 80 acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 6 inches thick. The subsoil is about 54 inches thick. In sequence downward, it is grayish brown, friable silty clay loam; dark brown, very firm silty clay; brown, very firm silty clay; and pale brown, firm, mottled silty clay loam. In some areas shale bedrock is at a depth of 40 to 60 inches.

Permeability is slow in the Crete soil. Surface runoff is slow. Available water capacity is high. Natural fertility is high. The organic matter content is moderate. The surface layer is friable and can be tilled throughout a fairly wide range in moisture content. The shrink-swell potential is high in the subsoil.

Nearly all of the acreage is used for cultivated crops. The rest is used for rangeland and tame grass pasture. This soil is well suited to wheat, grain sorghum, soybeans, and alfalfa. The clayey subsoil, however, restricts the movement of water and air and root development and slowly releases water to plants. A system of conservation tillage that leaves all or part of the crop residue on the surface improves fertility and tilth and increases the rate of water infiltration.

This soil is poorly suited to dwellings and septic tank absorption fields. It is moderately well suited to sewage lagoons. The shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations, installing sealed foundation drains, and backfilling with suitable coarse textured material help to prevent structural damage caused by shrinking and swelling. The slow permeability restricts the absorption of effluent in the septic tank absorption fields. It can be overcome by enlarging the field or by installing the lateral lines below the subsoil. Seepage is a limitation on sites for sewage lagoons. It can be controlled by sealing the lagoon.

The land capability classification is II<sub>s</sub>, and the range site is Clay Upland.

### **Cs—Crete silty clay loam, 1 to 4 percent slopes**



Figure 6.—Contour farming in an area of Crete silty clay loam, 1 to 4 percent slopes.

This very deep, gently sloping, moderately well drained soil is on ridgetops and side slopes. Individual areas are irregular in shape and range from 20 to 1,000 acres in size.

Typically, the surface layer is dark grayish brown silty clay loam about 6 inches thick. The subsoil is about 57 inches thick. In sequence downward, it is grayish brown, friable silty clay loam; brown, very firm silty clay; brown, very firm silty clay; and pale brown, firm, mottled silty clay loam. In some places the surface has been thinned by erosion and is silty clay. In some areas shale bedrock is at a depth of 40 to 60 inches.

Included with this soil in mapping are small areas of Clime and Sogn soils. The moderately deep, calcareous Clime soils and very shallow Sogn soils are on side slopes below the Crete soil. Included soils make up about 10 percent of the map unit.

Permeability is slow in the Crete soil. Surface runoff is medium. Available water capacity is high. Natural fertility is high. The organic matter content is moderate. The surface layer is friable and can be tilled throughout a fairly wide range in moisture content. The shrink-swell potential is high in the subsoil.

Nearly all of the acreage is used for cultivated crops. The rest is used for rangeland and tame grass

pasture. This soil is well suited to wheat, grain sorghum, soybeans, and alfalfa. Water erosion is a hazard if cultivated crops are grown. Terraces, grassed waterways, and contour farming help prevent excessive soil loss (fig. 6). A system of conservation tillage that leaves all or part of the crop residue on the surface improves fertility and tilth and increases the rate of water infiltration.

This soil is well suited to rangeland and tame grass pasture. The native vegetation is dominantly big bluestem, little bluestem, and switchgrass. Overgrazing reduces the extent of the plant cover and causes deterioration of the plant community. Under these conditions the more desirable grasses are replaced by less desirable grasses and by weeds. Proper stocking rates, rotation grazing, and timely deferment of grazing helps keep the grass in good condition. Invasion of woody plants has occurred in some places. Timely burning and proper use of chemicals helps to control these plants. Application of fertilizer and timely mowing of tame grass pasture increases plant vigor, quality, and quantity.

This soil is poorly suited to dwellings and septic tank absorption fields. It is moderately well suited to sewage lagoons. The shrink-swell potential is a limitation on sites for dwellings. Properly designing and

reinforcing foundations, installing sealed foundation drains, and backfilling with suitable coarse textured material help to prevent structural damage caused by shrinking and swelling. The slow permeability restricts the absorption of effluent in septic tank absorption fields. It can be overcome by enlarging the field or by installing the lateral lines below the subsoil. Seepage is a limitation on sites for sewage lagoons. It can be controlled by sealing the lagoon.

The land capability classification is IIe, and the range site is Clay Upland.

### **Ct—Crete silty clay loam, 3 to 8 percent slopes**

This very deep, moderately sloping, moderately well drained soil is on side slopes. Individual areas are irregular in shape and range from 5 to 1,500 acres in size.

Typically, the surface layer is very dark gray silty clay loam about 4 inches thick. The subsurface layer is very dark grayish brown silty clay loam about 4 inches thick. The subsoil is about 34 inches thick. The upper part is dark brown, very firm, mottled silty clay; the next part is dark grayish brown, very firm, mottled silty clay; and the lower part is brown, firm, mottled silty clay loam. The substratum to a depth of about 60 inches is yellowish brown, firm silty clay loam. In some areas the surface layer has been thinned by erosion and is silty clay. In other areas shale bedrock is at a depth of 40 to 60 inches.

Included with this soil in mapping are small areas of Kahola, Clime, and Sogn soils. The occasionally flooded Kahola soils are on flood plains of small drainageways. The moderately deep, calcareous Clime soils and very shallow Sogn soils are on side slopes below the Crete soil. Included soils make up about 15 percent of the map unit.

Permeability is slow in the Crete soil. Surface runoff is rapid. Available water capacity is high. Natural fertility is high. The organic matter content is moderate. The surface layer is friable and can be tilled throughout a fairly narrow range in moisture content. The shrink-swell potential is high in the subsoil.

Nearly all of the acreage is used for cultivated crops. The rest is used for rangeland and tame grass pasture. This soil is well suited to wheat, grain sorghum, soybeans, and alfalfa. Water erosion is a hazard if cultivated crops are grown. Terraces, grassed waterways, and contour farming help prevent excessive soil loss. A system of conservation tillage that leaves all or part of the crop residue on the surface improves fertility and tilth and increases the rate of water infiltration.

This soil is well suited to rangeland and tame grass pasture. The native vegetation is dominantly big bluestem, little bluestem, and switchgrass. Overgrazing reduces the extent of the plant cover and causes deterioration of the plant community. Under these conditions the more desirable grasses are replaced by less desirable grasses and by weeds. Proper stocking rates, timely deferment of grazing, and a uniform distribution of grazing help keep the range in good condition. Invasion of woody plants has occurred in some places. Timely burning and proper use of chemicals helps to control these plants. Application of fertilizer and timely mowing of tame grass pasture increases plant vigor, quality, and quantity.

This soil is poorly suited to dwellings and septic tank absorption fields. It is moderately well suited to sewage lagoons. The shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations, installing sealed foundation drains, and backfilling with suitable coarse textured material help to prevent structural damage caused by shrinking and swelling. The slow permeability restricts the absorption of effluent in septic tank absorption fields. It can be overcome by enlarging the field or by installing the lateral lines below the subsoil. Seepage and the slope are limitations on sites for sewage lagoons. Seepage can be controlled by sealing the lagoon. If the less sloping areas are selected as sites for lagoons, less leveling and banking will be needed during construction.

The land capability classification is IIIe, and the range site is Clay Upland.

### **Eu—Eudora silt loam, occasionally flooded**

This very deep, nearly level, well drained soil is on flood plains. Individual areas are irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The subsurface layer is silt loam. The upper part is very dark grayish brown and the lower part is dark grayish brown. The substratum to a depth of about 60 inches is pale brown and very pale brown silt loam in the upper part; the next part is stratified very pale brown with light brownish gray silt loam; and the lower part is very pale brown very fine sandy loam. In some places the surface is very fine sandy loam.

Included with this soil in mapping are a few small areas of McCook and Sarpy soils. The McCook soils are calcareous at or near the surface. The sandy, excessively drained Sarpy soils are on small mounds. Also included in mapping are areas that have fine sand

or loamy fine sand deposited by the flood of 1951. This deposit varies in thickness from 12 to about 36 inches. Some areas have been deep-plowed in an effort to reclaim them and have further altered the material. Included soils make up about 15 percent of the map unit.

Permeability is moderate in the Eudora soil. Surface runoff is slow. Available water capacity is high. Natural fertility is high. Organic matter content is high. The surface layer is friable and can be tilled throughout a wide range in moisture content. The shrink-swell potential is low in the subsoil.

Nearly all of the acreage is used for cultivated crops. This soil is well suited to wheat, grain sorghum, and alfalfa. Flooding and soil blowing are hazards if cultivated crops are grown. Flooding delays planting and harvesting and damages crops in some years, but in other years the extra moisture may increase crop yields. Overcoming the hazard of flooding is difficult without major flood-control measures. A system of conservation tillage that leaves all or part of the crop residue on the surface improves fertility and tilth and increases the rate of water infiltration.

This soil is generally unsuited to dwellings because of the flooding. Dikes, levees, and other structures lessen this hazard.

This soil is generally unsuited to septic tank absorption fields and sewage lagoons. The flooding is a hazard affecting septic tank systems. Levees reduce this hazard. Seepage is a limitation affecting sewage lagoons. It can be controlled by sealing the lagoon.

The land capability classification is IIw, and the range site is Loamy Lowland.

### **Ge—Geary silt loam, 3 to 8 percent slopes**

This very deep, moderately sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from 5 to 400 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 18 inches thick. The subsoil extends to a depth of about 60 inches. The upper part is brown, friable silty clay loam; the next part is brown, firm silty clay loam; and the lower part is strong brown, firm silty clay loam. In some places the surface layer has been thinned by erosion and is dark brown silty clay loam.

Included with this soil in mapping are small areas of Clime, Crete, and Sogn soils. The moderately deep, calcareous Clime soils are on side slopes below the Geary soil. The moderately well drained Crete soils contain more clay in the subsoil than the Geary soil. The very shallow Sogn soils are on side slopes below

the Geary soil. Included soils make up about 15 percent of the map unit.

Permeability is moderate in the Geary soil. Surface runoff is medium. Natural fertility is medium. Organic matter content is moderate. Available water capacity is moderate. The shrink-swell potential is moderate in the subsoil. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Nearly all of the acreage is used for cultivated crops. This soil is well suited to wheat, grain sorghum, soybeans, and alfalfa. Water erosion is a hazard if cultivated crops are grown. Terraces, grassed waterways, and contour farming help prevent excessive soil loss. A system of conservation tillage that leaves all or part of the crop residue on the surface improves fertility and tilth and increases the rate of water infiltration.

This soil is moderately well suited to dwellings. The shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations, installing sealed foundation drains, and backfilling with suitable coarse textured material help to prevent structural damage caused by shrinking and swelling.

This soil is moderately well suited to septic tank absorption fields and sewage lagoons. The moderate permeability restricts the absorption of effluent in septic tank absorption fields. It can be overcome by enlarging the field. Seepage and the slope are limitations on sites for sewage lagoons. Seepage can be controlled by sealing the lagoon. If the less sloping areas are selected as sites for lagoons, less leveling and banking will be needed during construction.

The land capability classification is IIIe, and the range site is Loamy Upland.

### **Gf—Geary silt loam, 7 to 15 percent slopes**

This very deep, strongly sloping, well drained soil is on side slopes along creeks and river valleys. Individual areas are irregular in shape and range from 50 to 500 acres in size.

Typically, the surface soil is dark grayish brown silt loam about 12 inches thick. The subsoil is silty clay loam about 30 inches thick. The upper part is dark brown and friable, and the lower part is brown and firm. The substratum to a depth of about 60 inches is brown silt loam.

Included with this soil in mapping are small areas of the moderately deep Clime soils and small areas of rock outcrop. These included areas are on the steeper slopes and breaks. Also included are narrow, deep gullies. The gullies are generally less than 75 feet wide and range from 8 to 15 feet deep. The sides are nearly

vertical breaks and the bottoms are silty material that has been deposited by water or by gravity flow from upslope. Included soils and areas make up about 10 percent of the map unit.

Permeability is moderate in the Geary soil. Surface runoff is rapid. Natural fertility is medium. Available water capacity is high. The organic matter content is moderate. The shrink-swell potential is moderate in the subsoil.

Nearly all areas are used as range. Because of a severe hazard of water erosion, this soil is generally unsuited to cultivated crops. It is better suited to range. The dominant native vegetation is big bluestem, little bluestem, and indiangrass. Overgrazed areas are dominated by blue grama, buffalograss, and sideoats grama. Water erosion is a hazard if range is overgrazed. In some areas gullies form along cattle trails. An adequate plant cover helps prevent excessive soil loss. Fencing and other means of controlling livestock traffic patterns can be used to prevent the formation of gullies and to give gullies time to revegetate. Proper stocking rates, a uniform distribution of grazing, and scheduled timely deferment of grazing during the growing season, help keep the range in good condition.

In a few areas, part of the vegetation is oak, ash, and hackberry. This vegetation provides habitat for many types of wildlife species, including quail, deer, rabbits, squirrels, and numerous songbirds. Proper grazing use and establishment of feed areas increase the wildlife population.

This soil is moderately well suited to dwellings. The shrink-swell potential and the slope are limitations on sites for dwellings. Properly designing and reinforcing foundations, installing sealed foundation drains, and backfilling with suitable coarse textured material help to prevent structural damage caused by shrinking and swelling.

This soil is moderately well suited to septic tank absorption fields and is poorly suited to sewage lagoons. The slope is a limitation that affects both uses. The moderate permeability restricts the absorption of effluent in septic tank absorption fields. It can be overcome by enlarging the field. Seepage is a limitation on sites for sewage lagoons. Seepage can be controlled by sealing the lagoon. If the less sloping areas are selected as site for lagoons, less leveling and banking will be needed during construction.

The land capability classification is VIe, and the range site is Loamy Upland.

### **He—Haynie silt loam, frequently flooded**

This very deep, nearly level, well drained soil is on

low flood plains. It is commonly adjacent to the major rivers in the county. Individual areas are generally in the shape of a half-moon on the inside of river channel meanders and range from 5 to 80 acres in size. Some areas are long and narrow ranging from 200 to 400 feet wide and 200 to 800 feet long.

Typically, the Haynie soil has a surface layer of dark grayish brown, calcareous silt loam about 10 inches thick. The substratum to a depth of about 60 inches is stratified light brownish gray, calcareous silt loam. In most places layers of more clayey strata less than 1 inch thick are in the substratum.

Included with this soil in mapping are soils that are silt loam to a depth of about 36 inches and are silty clay loam or silty clay from 36 to 60 inches. Also included are soils that have strata of silty clay loam or silty clay 4 to 12 inches thick below 12 inches. Near the river channel are inclusions of sandy deposits from recent floods. These deposits generally do not support vegetation and have a water table at shallow depths. These included soils make up about 45 percent of the map unit.

Permeability is moderate in the Haynie soil. Surface runoff is slow. Available water capacity is low. Natural fertility and organic matter content are low. The surface layer is friable and easily tilled throughout a wide range in moisture. Shrink-swell is low.

Nearly all of the acreage is used as wildlife habitat. These soils are generally unsuited to cultivated crops because of flooding. The vegetation is mostly cottonwood and hackberry and an understory of mid and tall grasses. This vegetation and the cultivated crops in nearby areas of arable soils provide habitat for many wildlife species, including deer, rabbits, squirrels, turkeys, and numerous songbirds. The adjacent river channels provide habitat for many wetland wildlife species, including ducks and geese.

This soil is well suited to timber and firewood production. Competition from less desirable trees or shrubs is the main concern for management. Trees best suited for planting are eastern cottonwood, green ash, and black walnut.

These soils are generally unsuitable for building site development because of the flooding. Overcoming this hazard is difficult without major flood-control measures.

The land capability classification is Vw, and the range site is Loamy Lowland.

### **Hf—Hobbs silt loam, channeled**

This very deep, nearly level, well drained soil is on narrow, low flood plains that are dissected by deeply entrenched drainageways. It is subject to frequent flooding for very brief periods. Individual areas range

from 150 to 500 feet wide and from 500 feet to more than a mile in length. They range from 25 to 150 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The substratum is very friable silt loam. The top layer is stratified grayish brown, with dark grayish brown and light brownish gray about 16 inches thick. The middle layer is brown about 20 inches thick. The bottom layer to a depth of about 60 inches is stratified brown, dark grayish brown, and light brownish gray.

Included with this soil in mapping are small areas of Crete, Geary, and Muir soils. Crete and Geary soils contain more clay in the subsoils and are on adjacent uplands. Muir soils are on adjacent high flood plains. Also included are soils that are calcareous to the surface, steep stream channels, and scour plains. Included soils make up about 15 percent of the map unit.

Permeability is moderate in the Hobbs soil. Surface runoff is slow. Available water capacity is high. Natural fertility is high. Organic matter content is moderate. Scouring and deposition occur along and near the stream channels.

Most areas of this soil are used as range or wildlife habitat. This soil is generally unsuited to cultivated crops because of flooding. Operating machinery is difficult along the meandering stream channels.

This soil is better suited to range and tame grass pasture. Control of brush and the distribution of grazing are the main concerns of management. In some areas the range is overgrazed and in poor condition because it is near water and shade trees where livestock congregate. In these areas, the more productive grasses are replaced by less productive grasses and by weeds. Rotation grazing and restricting grazing to winter help maintain the range in good condition. Controlled burning, proper use of chemicals, and selective cutting help to control woody plants.

The vegetation commonly growing on this soil provides habitat for many types of wildlife species, including quail, deer, rabbits, turkeys, and numerous songbirds. The wildlife population can be increased by establishing more fringe areas where woodland is adjacent to cropland.

This soil is well suited to timber and firewood production. Trees best suited to planting are black walnut, hackberry, green ash, and eastern cottonwood. Competition from less desirable trees and shrubs are the main concern for management.

This soil is generally unsuited to building site development because of flooding. Overcoming this hazard is difficult without major flood-control measures.

The land capability classification is Vw, and the range site is Loamy Lowland.

### **Hg—Hobbs silt loam, occasionally flooded**

This very deep, nearly level, well drained soil is on narrow flood plains. Individual areas range from 150 to 500 feet wide and from 500 feet to more than a mile in length. They range from 25 to 150 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 8 inches thick. The substratum to a depth of 60 inches is very friable silt loam. The upper part is stratified grayish brown, with dark grayish brown, and light brownish gray; the next part is brown; and the lower part is stratified brown, dark grayish brown, and light brownish gray.

Included with this soil in mapping are small areas of Crete, Geary, and Muir soils. Crete and Geary soils contain more clay in the subsoils and are on adjacent uplands. Muir soils are on adjacent high flood plains. Also included are soils that are calcareous to the surface, steep stream channels, and scour plains. Included soils make up about 15 percent of the map unit.

Permeability is moderate in the Hobbs soil. Surface runoff is slow. Available water capacity is high. Natural fertility is high. Organic matter content is moderate. The surface layer is friable and easily tilled throughout a wide range in moisture content.

About half of the acreage is used for cultivated crops. The rest is range or wildlife habitat. This soil is well suited to wheat, grain sorghum, and alfalfa. Crop yields are reduced in some years because of flooding. The main management concern is maintenance of fertility and tilth. A system of conservation tillage that leaves all or part of the crop residue on the surface improves fertility and tilth and increases the rate of water infiltration.

Areas along streams channels and edge areas where cropland is adjacent to range or woodland provide habitat for many kinds of wildlife, including quail, deer, rabbits, turkeys, and numerous songbirds. The habitat can be improved by planting trees or shrubs or by leaving small areas of unharvested crops along the edge of the cropland.

This soil is well suited to timber and firewood production. Trees best suited to planting are black walnut, hackberry, green ash, and eastern cottonwood. Competition from less desirable trees and shrubs is the main concern for management.

This soil is generally unsuited to dwellings, septic tank absorption fields, and sewage lagoons because of

the flooding. Dikes, levees, and other structures lessen this hazard.

The land capability classification is IIw, and the range site is Loamy Lowland.

### **Hm—Holder silt loam, 1 to 3 percent slopes**

This very deep, gently sloping, well drained soil is on ridgetops. Individual areas are irregular in shape and range from 10 to 200 acres in size.

Typically, the surface layer is grayish brown silt loam about 12 inches thick. The subsoil is about 37 inches thick. The upper part is grayish brown, friable silty clay loam; the next part is brown, friable silty clay loam; and the lower part is pale brown, firm silty clay loam. The substratum to a depth of 60 inches is pale brown silt loam. In some areas the subsoil is reddish brown.

Included with this soil in mapping are small areas of Crete soils. Crete soils contain more clay in the subsoils and are on nearly level or slightly depressional areas. Included soils make up about 5 percent of the map unit.

Permeability is moderate in the Holder soil. Surface runoff is medium. Available water capacity is moderate. Natural fertility is medium. Organic matter content is moderate. The surface layer is friable and easily tilled throughout a wide range in moisture content. The shrink-swell potential is moderate in the subsoil.

About half of the acreage is used for cultivated crops, and half is used for range or wildlife habitat. This soil is well suited to wheat, grain sorghum, alfalfa, and soybeans. Water erosion is a hazard if cultivated crops are grown. Terraces, grassed waterways, and contour farming help prevent excessive soil loss. A system of conservation tillage that leaves all or part of the crop residue on the surface improves fertility and tilth and increases the rate of water infiltration.

This soil is suited to range. The dominant native vegetation is big bluestem, little bluestem, and switchgrass. Overgrazed areas are dominated by blue grama, buffalograss, and sideoats grama. Proper stocking rates, a uniform distribution of grazing, and scheduled timely deferment of grazing during the growing season, help keep the range in good condition.

This soil is moderately well suited to dwellings. The shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations, installing sealed foundation drains, and backfilling with suitable coarse textured material help to prevent structural damage caused by shrinking and swelling.

This soil is moderately well suited to septic tank

absorption fields and sewage lagoons. The moderate permeability restricts the absorption of effluent in septic tank absorption fields. It can be overcome by enlarging the field. Seepage and slope are a limitation on sites for sewage lagoons. Seepage can be controlled by sealing the lagoon. If the less sloping areas are selected as sites for lagoons, less leveling and banking will be needed during construction.

The land capability classification is IIe, and the range site is Loamy Upland.

### **Ho—Holder silt loam, 3 to 7 percent slopes**

This very deep, moderately sloping, well drained soil is on side slopes along creeks and river valleys. Individual areas are irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is grayish brown silt loam about 14 inches thick. The subsoil is about 44 inches thick and friable. The upper part is brown silty clay loam, the next part is pale brown silty clay loam, and the lower part is pale brown silt loam. The substratum to a depth of 60 inches is brown silt loam. In some areas the subsoil is reddish brown. In other areas the subsoil is silt loam.

Included with this soil in mapping are small areas of Clime and Crete soils. The moderately deep Clime soils are on middle and lower side slopes. The Crete soils contain more clay in the subsoil and are on the upper parts of side slopes. Included soils make up about 15 percent of the map unit.

Permeability is moderate. Surface runoff is medium. Available water capacity is moderate. Natural fertility is medium. Organic matter content is moderate. The surface layer is friable and easily tilled throughout a wide range in moisture content. The shrink-swell potential is moderate in the subsoil.

About half of the acreage is used for cultivated crops, and half is used for range or wildlife habitat. This soil is moderately well suited to wheat, grain sorghum, and soybeans. Water erosion is a hazard if cultivated crops are grown. Terraces, grassed waterways, and contour farming help prevent excessive soil loss. A system of conservation tillage that leaves all or part of the crop residue on the surface improves fertility and tilth and increases the rate of water infiltration.

This soil is suited to range. The dominant native vegetation is big bluestem, little bluestem, and switchgrass. Overgrazed areas are dominated by blue grama, buffalograss, and sideoats grama. Water erosion is a hazard if range is overgrazed. In some areas, gullies form along cattle trails. An adequate plant cover helps prevent excessive soil loss. Fencing

and other means of controlling livestock traffic patterns can be used to prevent the formation of gullies and to give gullies time to revegetate. Proper stocking rates, a uniform distribution of grazing, and scheduled timely deferment of grazing during the growing season, help keep the range in good condition.

This soil is moderately well suited to dwellings. The shrink-swell potential is a limitation. Properly designing and reinforcing foundations, installing sealed foundation drains, and backfilling with suitable coarse textured material help to prevent structural damage caused by shrinking and swelling.

This soil is moderately well suited to septic tank absorption fields and sewage lagoons. The moderate permeability restricts the absorption of effluent in septic tank absorption fields. It can be overcome by enlarging the field. Seepage and slope are limitations on sites for sewage lagoons. Seepage can be controlled by sealing the lagoon. If the less sloping areas are selected as sites for lagoons, less leveling and banking will be needed during construction.

The land capability classification is IIIe, and the range site is Loamy Upland.

### **Id—Irwin silty clay loam, 3 to 7 percent slopes**

This very deep, moderately sloping, moderately well drained soil is on side slopes. Individual areas are irregular in shape and range from 10 to several thousand acres in size.

Typically, the surface layer is very dark gray silty clay loam about 6 inches thick. The subsurface layer is very dark grayish brown silty clay loam 7 inches thick. The subsoil to a depth of 60 inches is very firm. In sequence downward, it is dark grayish brown clay, brown clay, brown silty clay, brown silty clay loam, and mixed dark brown and brown silty clay loam. In some areas where the surface has been thinned by erosion, it is silty clay and has lighter colors. In other places, the depth to bedrock is less than 60 inches.

Included with this soil in mapping are small areas of Clime, Florence, and Tully soils. The moderately deep Clime soils are on side slopes. The deep, gravelly Florence soils are on shoulder slopes and side slopes. The deep Tully soils are on foot slopes below the Irwin soils. Included soils make up about 15 percent of the map unit.

Permeability is very slow in the Irwin soil. Surface runoff is rapid. Available water capacity is moderate. Natural fertility is medium. Organic matter content is moderate. The surface layer is friable and tilth is fair. If the soil is tilled when too wet or too dry, clods form and

structure is destroyed. The shrink-swell potential is high in the subsoil.

Nearly all of the acreage is used for cultivated crops. The rest is used for range or tame grass pasture. This soil is suited to wheat, alfalfa, grain sorghum, and soybeans. Water erosion is a hazard if cultivated crops are grown. Terraces, grassed waterways, and contour farming help prevent excessive soil loss. A system of conservation tillage that leaves all or part of the crop residue on the surface improves fertility and tilth and increases the rate of water infiltration.

This soil is suited to range and pasture. The native vegetation is dominantly big bluestem, little bluestem, indiangrass, and switchgrass. Water erosion is a hazard if the range is overgrazed. In some areas gullies form along cattle trails. An adequate plant cover helps prevent excessive soil loss. Fencing and other means of controlling livestock traffic patterns can be used to prevent the formation of gullies and to give gullies time to revegetate. Proper stocking rates, a uniform distribution of grazing, and scheduled timely deferment of grazing during the growing season, help keep the range in good condition. Early mowing of hay allows the plants to recover and store food before the first frost. Application of fertilizer increases forage production of tame grass pasture. Invasion of woody plants, such as Osage-orange and eastern redcedar, is a problem in some areas. Timely burning helps to control these plants.

This soil is poorly suited to dwellings. The shrink-swell potential is a limitation. Using properly designed and reinforced foundations, installing sealed foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and swelling.

This soil is poorly suited to septic tank absorption fields and is moderately well suited to sewage lagoons. The slow permeability restricts the absorption of effluent in septic tank absorption fields. It can be overcome by enlarging the field. The slope is a moderate limitation on sites for sewage lagoons. If the less sloping areas are selected as sites for lagoons, less leveling and banking will be needed during construction.

The land capability classification is IVe, and the range site is Clay Upland.

### **Ka—Kahola silt loam, channeled**

This very deep, nearly level, well drained soil is on narrow, low flood plains that are dissected by stream channels. It is frequently flooded for very brief periods. Individual areas range from 150 to 800 feet wide and

from 500 feet to more than a mile in length. These areas range from 25 to 150 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 6 inches thick. The subsurface layer is very dark grayish brown and dark grayish brown silt loam about 18 inches thick. The next layer is dark grayish brown calcareous, very friable silt loam about 20 inches thick. The substratum to a depth of about 60 inches is brown, very friable silt loam. In some places the upper half of this soil contains thin strata of contrasting color.

Included with this soil in mapping are small areas of Reading and Tully soils and soils that have greater than 35 percent gravel below a depth of 12 inches. The Reading soils contain more clay in the subsoil and are on adjoining higher flood plains. The Tully soils contain more clay in the subsoil and are on foot slopes in adjoining uplands. Also included with this soil in mapping are steep stream channels, rock and gravel bars, and scour plains. Other included soils are calcareous to the surface. Included soils make up about 25 percent of the map unit.

Permeability is moderate in the Kahola soils. Surface runoff is slow. Available water capacity is high. Natural fertility is high. Organic matter content is moderate. The shrink-swell potential is moderate in the subsoil.

The majority of the acreage is used as range or wildlife habitat. A few areas are used for cultivated crops. However, this soil is generally unsuited to cultivated crops because of flooding. It is also difficult to use machinery along the meandering stream channels.

This soil is better suited to range and tame grass pasture. Control of brush and distribution of grazing are the main concerns of management. In some areas the range is overgrazed and in poor condition because it is near water and shade trees where livestock congregate. In these areas, the more productive grasses are replaced by less productive grasses and by weeds. Rotation grazing and restricting grazing to winter help maintain the range in good condition. Controlled burning, proper use of chemicals, and selective cutting help to control woody plants.

This soil is well suited to timber and firewood production. Trees best suited to planting are black walnut, hackberry, green ash, and eastern cottonwood. Competition from less desirable trees and shrubs is the main concern for management.

The vegetation commonly growing on this soil provides habitat for many types of wildlife species, including quail, deer, rabbits, and numerous songbirds. The wildlife population can be increased by

establishing more fringe areas where woodland is adjacent to cropland.

This soil is generally unsuited to building site development because of flooding. Overcoming this hazard is difficult without major flood-control measures.

The land capability classification is Vw, and the range site is Loamy Lowland.

### **Kb—Kahola silt loam, occasionally flooded**

This very deep, nearly level, well drained soil is on narrow flood plains that are dissected by stream channels. Individual areas range from 150 to 800 feet wide and from 500 feet to more than a mile in length. They range from 25 to 150 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 6 inches thick. The subsurface layer is silt loam about 18 inches. The upper part is very dark grayish brown, and the lower part dark grayish brown. The next layer is dark grayish brown, calcareous, very friable silt loam about 20 inches thick. The substratum to a depth of about 60 inches is brown, very friable silt loam. In some places the upper half of this soil contains thin strata of contrasting color.

Included with this soil in mapping are small areas of Reading and Tully soils. The Reading soils contain more clay in the subsoil and are on higher flood plains. The Tully soils contain more clay in the subsoil and are on foot slopes in adjoining uplands. Also included with this soil in mapping are steep stream channels and short, steep escarpments to adjoining higher or lower bottom lands. Other included soils are calcareous to the surface. Included soils make up about 25 percent of the map unit.

Permeability is moderate in the Kahola soil. Surface runoff is slow. Available water capacity is high. Natural fertility is high. Organic matter content is moderate. The surface layer is friable and easily tilled throughout a wide range in moisture content. The shrink-swell potential is moderate in the subsoil.

About half of the acreage is used for cultivated crops the rest is range or wildlife habitat. This soil is well suited to wheat, sorghum, soybeans, and alfalfa. Crop yields are reduced in some years because of flooding. The main management concern is maintenance of fertility and tilth. A system of conservation tillage that leaves all or part of the crop residue on the surface improves fertility and tilth and increases the rate of water infiltration.

The vegetation commonly growing on this soil provides habitat for many types of wildlife species, including quail, deer, rabbits, turkeys, and numerous songbirds. The wildlife population can be increased by



Figure 7.—Native hay in an area of Konza silty clay loam, 1 to 3 percent slopes.

establishing more fringe areas where woodland is adjacent to cropland.

This soil is well suited to timber and firewood production. Trees best suited to planting are black walnut, hackberry, green ash, and eastern cottonwood. Competition from less desirable trees and shrubs is the main concern for management.

This soil is generally unsuited to dwellings, septic tank absorption fields, and sewage lagoons because of flooding. Dikes, levees, and other structures lessen this hazard.

The land capability classification is IIw, and the range site is Loamy Lowland.

### **Ko—Konza silty clay loam, 1 to 3 percent slopes**

This very deep, gently sloping, moderately well drained soil is on ridgetops and shoulder slopes.

Individual areas are irregular in shape and range from 10 to 500 acres in size.

Typically, the surface layer is very dark gray silty clay loam about 6 inches thick. The subsoil is about 44 inches thick. In sequence downward, it is dark grayish brown, very firm silty clay; brown, firm silty clay; mixed brown and grayish brown, firm silty clay loam; and mixed grayish brown and light grayish brown silty clay loam. The substratum to a depth of 80 inches is brown and dark brown. The upper layer is silty clay loam, and the lower layer is silty clay. In some places where the surface has been thinned by erosion it is silty clay. In other places the depth to bedrock is less than 40 inches.

Included with this soil in mapping are small areas of Clime, Florence, and Ladysmith soils and slick spots. The moderately deep Clime soils are on side slopes. The deep, gravelly Florence soils are on shoulder slopes and side slopes below Konza soils. The

somewhat poorly drained Ladysmith soils have a grayer subsoil and are on level areas on ridgetops. The slick spots have a thinner surface, more exchangeable sodium in the subsoil than the Konza soils, and are in slight depressions. Included soils make up about 15 percent of the map unit.

Permeability is slow in the Konza soil. Surface runoff is medium. Available water capacity is moderate. Natural fertility is medium. Organic matter content is moderate. The surface layer is friable and tilth is fair. If the soil is tilled when too wet or too dry, clods form and structure is destroyed. The shrink-swell potential is high in the subsoil.

Nearly all of the acreage is used for cultivated crops. This soil is suited to wheat, alfalfa, grain sorghum, and soybeans. Water erosion is a hazard if cultivated crops are grown. Terraces, grassed waterways, and contour farming help prevent excessive soil loss. A system of conservation tillage that leaves all or part of the crop residue on the surface improves fertility and tilth and increases the rate of water infiltration.

This soil is suited to range and pasture. The native vegetation is dominantly big bluestem, little bluestem, indiangrass, and switchgrass. Water erosion is a hazard if the range is overgrazed. In some areas gullies form along cattle trails. An adequate plant cover helps prevent excessive soil loss. Fencing and other means of controlling livestock traffic patterns can be used to prevent the formation of gullies and to give gullies time to revegetate. Proper stocking rates, a uniform distribution of grazing, and scheduled timely deferment of grazing during the growing season, help keep the range in good condition. Early mowing of hay allows the plants to recover and store food before the first frost (fig. 7). Application of fertilizer increases forage production of tame grass pasture. Invasion of woody plants, such as Osage-orange and eastern redcedar, is a problem in some areas. Timely burning helps to control these plants.

This soil is poorly suited to dwellings. The shrink-swell potential is a limitation. Using properly designed and reinforced foundations, installing sealed foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and swelling.

This soil is poorly suited to septic tank absorption fields and is moderately well suited to sewage lagoons. The slow permeability restricts the absorption of effluent in septic tank absorption fields. It can be overcome by enlarging the field. The slope is a moderate limitation on sites for sewage lagoons. If the less sloping areas are selected as sites for lagoons,

less leveling and banking will be needed during construction.

The land capability classification is IIIe, and the range site is Clay Upland.

### **Lm—Ladysmith silty clay loam, 0 to 2 percent slopes**

This very deep, nearly level, somewhat poorly drained soil is on broad ridgetops. Individual areas are irregular in shape and range from 50 to 500 acres in size.

Typically, the surface layer is dark gray silty clay loam about 7 inches thick. The subsoil is about 41 inches thick and very firm. The upper part is dark gray silty clay, the next part is dark gray mottled clay, and the lower part is pale brown mottled clay. The substratum to a depth of about 60 inches is pale brown and very pale brown, mottled silty clay. In some places the surface layer and the upper subsoil are lighter colored above 20 inches. In other places the depth to bedrock is less than 60 inches.

Included with this soil in mapping are small areas of the moderately well drained Konza soils and slick spots. Konza soils have a thinner surface and are on similar positions as the Ladysmith soils. The slick spots have a thinner surface and more exchangeable sodium in the subsoil and are in slight depressions. Included soils make up about 10 percent of the map unit.

Permeability is very slow in the Ladysmith soil. Surface runoff is slow. Available water capacity is moderate. Natural fertility is high. Organic matter content is moderate. The surface layer is firm and easily tilled only within a narrow range in moisture content. If tilled when too wet or too dry, clods form and structure is destroyed. The shrink-swell potential is high in the subsoil. A perched seasonal high water table is at a depth of about 2 to 3 feet in the winter and early spring.

Nearly all of the acreage is used for cultivated crops. This soil is well suited to wheat, soybeans, grain sorghum, and alfalfa. In some years crop yields are reduced by wetness. Yields can also be reduced during periods of drought because the clayey subsoil does not readily release water to plants. Water erosion is a hazard if cultivated crops are grown. A system of conservation tillage that leaves all or part of the crop residue on the surface improves fertility and tilth and increases the rate of water infiltration.

This soil is suited to tame and native grasses. The native vegetation is dominantly big bluestem, little bluestem, and switchgrass. If the range is overgrazed these grasses are replaced by less desirable grasses

and by weeds, such as tall dropseed, broomweed, and western ragweed. Grazing when the soil is too wet causes surface compacting. Proper stocking rates, a uniform distribution of grazing, and scheduled timely deferment of grazing during the growing season, help keep the range in good condition. Timely mowing of these grasses for hay allows the plants to recover and store food before the first frost. Applications of fertilizer are generally needed to improve the vigor, quality, and quantity of tame grasses.

This soil is poorly suited to dwellings. The shrink-swell potential is a limitation on sites for dwellings with or without basements. Also, wetness is a limitation on sites for dwellings with basements. Properly designing and reinforcing foundations, installing sealed foundation drains, and backfilling with coarse textured material around the foundation help to prevent the structural damage caused by wetness and by shrinking and swelling.

This soil is generally unsuited to septic tank absorption fields because of wetness and very slow permeability. This soil is well suited to sewage lagoons.

The land capability classification is II<sub>s</sub>, and the range site is Clay Upland.

### **Lo—Longford loam, 1 to 3 percent slopes**

This very deep, gently sloping, well drained soil is on ridgetops and upper side slopes. Individual areas are irregular in shape and range from 10 to 500 acres in size.

Typically, the surface soil is dark grayish brown loam about 11 inches thick. The subsoil is about 43 inches thick. The upper part is mixed dark grayish brown and dark brown, firm clay loam, and the lower part is brown, very firm clay loam. The substratum to a depth of about 60 inches is brown loam. In areas where the surface has been thinned by erosion, it is clay loam.

Included with this soil in mapping are small areas of Crete and Ortello soils. Crete soils have a browner subsoil than the Longford soils and are on ridgetops. Ortello soils contain more sand in the subsoil than the Longford soil and are on small mounds. Included soils make up about 15 percent of the map unit.

Permeability is slow in the Longford soil. Surface runoff is medium. Available water capacity is high. Natural fertility is high. Organic matter content is moderate. The surface layer is friable and easily tilled. The shrink-swell potential of the subsoil is high.

Nearly all of the acreage is used for cultivated crops. This soil is well suited to wheat, grain sorghum, and alfalfa. Water erosion is a hazard if cultivated crops are grown. Terraces, grassed waterways, and contour

farming help prevent excessive soil loss. A system of conservation tillage that leaves all or part of the crop residue on the surface improves fertility and tilth and increases the rate of water infiltration.

This soil is well suited to rangeland and tame grass pasture. The native vegetation is dominantly big bluestem, little bluestem, and switchgrass. Water erosion is a hazard if range is overgrazed. In some areas gullies form along cattle trails. An adequate plant cover helps prevent excessive soil loss. Fencing and other means of controlling livestock traffic patterns can be used to prevent the formation of gullies and to give gullies time to revegetate. Proper stocking rates, a uniform distribution of grazing, and scheduled timely deferment of grazing during the growing season, help keep the range in good condition. Application of fertilizer and timely mowing of tame grass pasture increases plant vigor, quality, and quantity.

This soil is poorly suited to dwellings and septic tank absorption fields. It is moderately well suited to sewage lagoons. The shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations, installing sealed foundation drains, and backfilling with suitable coarse textured material help to prevent structural damage caused by shrinking and swelling.

The slow permeability restricts the absorption of effluent in septic tank absorption fields. It can be overcome by enlarging the field or by installing the lateral lines below the subsoil. The slope is a limitation on sites for sewage lagoons. If the less sloping areas are selected as sites for lagoons, less leveling and banking will be needed during construction.

The land capability classification is II<sub>e</sub>, and the range site is Loamy Upland.

### **Mb—McCook silt loam, occasionally flooded**

This very deep, nearly level, well drained soil is on flood plains along major rivers. Slopes are 0 to 1 percent. Individual areas are irregular in shape and range from 20 to 300 acres in size. Slopes are 0 to 1 percent.

Typically, the surface layer is grayish brown, calcareous silt loam about 8 inches thick. The subsurface layer is grayish brown, calcareous silt loam about 8 inches thick. The next layer is light brownish gray, calcareous silt loam. The substratum to a depth of about 60 inches is calcareous silt loam. The upper part is pale brown, the next part is light brownish gray, and the lower part is stratified grayish brown and light brownish gray. The substratum is stratified throughout. These strata vary in thickness and texture. In places

the surface layer is light brownish gray silt loam and very fine sandy loam about 10 inches thick. This lighter colored material was deposited during the 1951 flood. In other places this layer has been mixed with the original surface as a result of cultivation.

Included with this soil in mapping are small areas of Eudora, Smokyhill, and Solomon soils. Eudora soils do not have carbonates within 20 inches of the surface. The moderately well drained Smokyhill soils contain more clay than the McCook soils and are in depressions. The poorly drained Solomon soils contain more clay than the McCook soils and are in abandoned channels and back water areas. Also included are short, steep escarpments to adjoining higher or lower bottom lands. Included soils make up about 20 percent of the map unit.

Permeability is moderate in the McCook soil. Surface runoff is slow. Available water capacity is high. Natural fertility is high. Organic matter content is moderate. The surface layer is friable and easily tilled throughout a wide range in moisture content. The shrink-swell potential is low.

Nearly all of the acreage is used for cultivated crops. It is well suited to wheat, grain sorghum, alfalfa, and soybeans. Flooding and soil blowing are hazards if cultivated crops are grown. Flooding delays planting and harvesting and damages crops in some years, but in other years the extra moisture may increase crop yields. Overcoming the hazard of flooding is difficult without major flood-control measures. Applying a system of conservation tillage that leaves all or part of the crop residue on the surface improves fertility and tilth and increases the rate of water infiltration.

Grain sorghum, soybeans, and corn are the main irrigated crops. Using water efficiently and maintaining soil fertility are management concerns. Controlling the rate of water application helps to conserve irrigation water and lowers the cost of operation.

This soil is generally unsuited to dwellings, septic tank absorption fields, and sewage lagoons because of the flooding. Dikes, levees, and other structures lessen this hazard.

The land capability classification is IIw, and the range site is Loamy Lowland.

### **Mc—McCook silt loam, rarely flooded**

This very deep, nearly level, well drained soil is on high flood plains along major rivers. Slopes are 0 to 1 percent. Individual areas are irregular in shape and range from 20 to 300 acres in size. Slopes are 0 to 1 percent.

Typically, the surface layer is very dark grayish brown silt loam about 19 inches thick. The subsurface

layer is dark grayish brown silt loam about 6 inches thick. The substratum to a depth of about 60 inches is calcareous silt loam. The upper part is brown, and the lower part is dark grayish brown. The whole substratum is stratified. These strata vary in thickness and texture. In places the surface layer is light brownish gray silt loam and very fine sandy loam about 10 inches thick. This lighter colored material was deposited during the 1951 flood. In other places this layer has been mixed with the original surface as a result of cultivation. In some areas the substratum may be mottled.

Included with this soil in mapping are small areas of Eudora and Smokyhill soils. The Eudora soils lack carbonates in the upper 20 inches and are lower on the flood plain. The moderately well drained Smokyhill soils contain more clay in the subsoil than the McCook soils and are in depressions. Included soils make up about 15 percent of the map unit.

Permeability is moderate in the McCook soil. Surface runoff is slow. Available water capacity is high. Natural fertility is high. Organic matter content is moderate. The surface layer is friable and easily tilled throughout a wide range in moisture content. The shrink-swell potential is low.

Nearly all of the acreage is used for cultivated crops. It is well suited to wheat, grain sorghum, alfalfa, and soybeans. The main management concern is maintenance of fertility and tilth. Applying a system of conservation tillage that leaves all or part of the crop residue on the surface improves fertility and tilth and increases the rate of water infiltration. Crop rotations help to control weeds, plant diseases, and insects.

Grain sorghum, soybeans, and corn are the main irrigated crops. Using water efficiently and maintaining soil fertility are management concerns. Controlling the rate of water application helps to conserve irrigation water and lowers the cost of operation.

This soil is poorly suited to dwellings and moderately well suited to septic tank absorption fields. The flooding is a hazard affecting both uses. Dikes, levees, and other structures can reduce the hazard of flooding. Onsite inspection and knowledge of the flooding history of the area are needed when building sites are selected. This soil is moderately well suited to sewage lagoons because of seepage. Sealing the lagoon helps to control seepage.

The land capability classification is I, and the range site is Loamy Terrace.

### **Mk—McCook-Smokyhill silt loams, occasionally flooded**

These very deep, nearly level soils are on flood plains along major rivers. The well drained McCook

soils are on the higher parts of the landscape, and the moderately well drained Smokyhill soils are usually in small depressions. Slopes are 0 to 2 percent. Individual areas are irregular in shape and range from 10 to 300 acres in size. They are about 50 percent McCook soil and 25 percent Smokyhill soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is impractical.

Typically, the McCook soil has a surface layer of very dark grayish brown silt loam about 12 inches thick. The subsurface layer is dark brown silt loam about 11 inches thick. The substratum to a depth of about 60 inches is calcareous silt loam. The upper part is brown, and the lower part is dark grayish brown. The whole substratum is stratified. These strata vary in thickness and texture. In places the surface layer is light brownish gray silt loam and very fine sandy loam about 10 inches thick. This lighter colored material was deposited during the 1951 flood. In other places this layer has been mixed with the original surface as a result of cultivation. In some areas the substratum may be mottled.

Typically, the Smokyhill has a surface layer of dark grayish brown, calcareous, silt loam about 6 inches thick. The subsurface layer is dark grayish brown, calcareous silty clay loam about 8 inches thick. The next layer is dark grayish brown, calcareous, firm silty clay loam about 16 inches thick. The substratum to a depth of about 72 inches is pale brown, calcareous silt loam. In some places the surface is less clayey. In other places there is a silty overwash on top of the Smokyhill soil.

Included with these soils in mapping are small areas of Sutphen soils. The Sutphen soils contain more clay throughout and are in positions on the landscape similar to those of the Smokyhill soil. Also included in mapping is a soil that contains more clay than McCook soils and has dark color at depths greater than 20 inches. Included soils make up about 25 percent of the map unit.

Permeability is moderate in the McCook soil and slow over moderate in the Smokyhill soil. Surface runoff is slow in both soils. Organic matter content is moderate in both soils. Available water capacity is high in both soils. Natural fertility is high in the McCook soil and medium in the Smokyhill soil. The surface layer of the McCook soil is friable and easily tilled throughout a wide range in moisture content. However, the surface layer of the Smokyhill soil is firm and tillage should be restricted during wet periods. The shrink-swell potential is low throughout the McCook soil. It is moderate in the upper part of the Smokyhill soil and low in the lower part.

Nearly all of the acreage is used for cultivated

crops. These soils are well suited to corn, grain sorghum, soybeans, wheat, and alfalfa. If cultivated crops are grown, flooding and soil blowing are hazards on both soils. Surface compacting is a problem if the Smokyhill soils are tilled when they are too wet. It can be minimized by timely tillage. Applying a system of conservation tillage that leaves all or part of the crop residue on the surface improves fertility and tilth and increases the rate of water infiltration.

The McCook and Smokyhill soils are generally unsuited to dwellings, septic tank absorption fields, and sewage lagoons because of the flooding. Dikes, levees, and other structures lessen this hazard.

The land capability classification is IIw, and the range site is Loamy Lowland for the McCook soils and Clay Lowland for the Smokyhill soils.

### **Mu—Muir silt loam, rarely flooded**

This very deep, nearly level, well drained soil is on high flood plains. Slopes are 0 to 2 percent. Individual areas are irregular in shape and range from 20 to several hundred acres in size.

Typically, the surface layer is dark gray silt loam about 16 inches thick. The subsoil is dark grayish brown, friable, silt loam about 28 inches thick. The substratum to a depth of about 60 inches is brown silt loam. In some places the surface layer is loam. In other places the subsoil contains more clay.

Included with this soil in mapping are small areas of the moderately well drained Sutphen soils. Sutphen soils contain more clay throughout and are in depressions. Also included in some areas are short sloping escarpments to the adjoining lower flood plain. Included areas make up about 5 percent of the map unit.

Permeability is moderate in the Muir soil. Surface runoff is slow. Available water capacity is high. Natural fertility is high. Organic matter content is high. The surface layer is friable and easily tilled throughout a wide range in moisture content. The shrink-swell potential is moderate.

Nearly all of the acreage is cultivated. This soil is well suited to wheat, grain sorghum, soybeans, and alfalfa. The main management concern is maintenance of fertility and tilth. Applying a system of conservation tillage that leaves all or part of the crop residue on the surface improves fertility and tilth and increases the rate of water infiltration.

Grain sorghum, soybeans, and corn are the main irrigated crops. Using water efficiently and maintaining soil fertility are management concerns. Controlling the rate of water application helps to conserve irrigation water and lowers the cost of operation.

This soil is poorly suited to dwellings and moderately well suited to septic tank absorption fields. The flooding is a hazard affecting both uses. Dikes, levees, and other structures can reduce the hazard of flooding. Onsite inspection and knowledge of the flooding history of the area are needed when building sites are selected. This soil is moderately well suited to sewage lagoons because of seepage. Sealing the lagoon helps to control seepage.

The land capability classification is I, and the range site is Loamy Terrace.

### **M-W—Miscellaneous water areas**

This map unit consists of small man-made water areas containing water most of the year. These areas are used for sanitary applications.

### **Oc—Orthents**

This map unit consists of areas from which the soil and much of the underlying gravel, sand, and limestone or shale have been removed. The exposed areas of limestone or shale range from 3 to 30 acres in size and have nearly vertical walls 10 to 30 feet high. They support few plants. Soil material in long, narrow pits along highways has been removed for use in highway construction. These pits support some grasses and trees and are frequently ponded.

This map unit is generally unsuited to cultivation and to most other uses. In areas where surface drainage is good, it can be planted to trees and grasses. If vegetation is reestablished, these areas are well suited to wildlife habitat. Planting woody species improves the diversity of the vegetation. More diverse vegetation commonly attracts additional wildlife species.

The land capability classification is VIIe. No range site is assigned.

### **Or—Orthents, earthen dam**

This map unit consists of areas where soil material was deposited to construct Milford Dam. The soil material is a mix of loamy and clayey material transported to the site from the reservoir area and compacted during construction of the Milford Lake.

### **Pt—Pits, quarries**

These are areas that have been excavated and the underlying soil and limestone rock have been removed.

The remaining pits have vertical walls and are bordered by overburden that contains the original soil mixed with shale and limestone. These areas are almost barren of vegetation.

The land capability classification is VIII. No range site is assigned.

### **Ra—Reading silt loam, 0 to 1 percent slopes**

This very deep, nearly level, well drained soil is on high flood plains. It is subject to rare flooding. Individual areas are irregular in shape and range from 5 to 30 acres in size.

Typically, the surface layer is very dark grayish brown silt loam about 8 inches thick. The subsurface layer is dark grayish brown silty clay loam about 12 inches thick. The subsoil is firm silty clay loam about 40 inches thick. The upper part is dark grayish brown, and the lower part is yellowish brown.

Included with this soil in mapping are small areas of Kahola and Tully soils. The Kahola soils are silty and are adjacent to the stream channel. The Tully soils contain more clay in the subsoil and are on more sloping areas in the adjoining uplands. Also included in some areas are short, sloping escarpments to the adjoining lower flood plain. Included soils make up about 15 percent of the map unit.

Permeability is moderately slow in the Reading soil. Surface runoff is slow. Available water capacity is high. Natural fertility is high. Organic matter content is moderate. The surface layer is friable and easily tilled throughout a wide range in moisture content. The shrink-swell potential is low.

Nearly all acreage is used for cultivated crops. This soil is well suited to wheat, grain sorghum, soybeans, and alfalfa. The main management concern is maintenance of fertility and tilth. Applying a system of conservation tillage that leaves all or part of the crop residue on the surface improves fertility and tilth and increases the rate of water infiltration. Crop rotations help to control weeds, plant diseases, and insects.

Grain sorghum, soybeans, and corn are the main irrigated crops. Using water efficiently and maintaining soil fertility are management concerns. Controlling the rate of water application helps to conserve irrigation water and lowers the cost of operation.

This soil is poorly suited to dwellings because of flooding. Dikes, levees, and other structures can reduce the hazard of flooding. Onsite inspection and knowledge of the flooding history of the area are needed when building sites are selected. This soil is poorly suited to septic tank absorption fields because of moderately slow permeability in the subsoil.

Moderately slow permeability restricts the absorption of effluent in septic tank absorption fields. It can be overcome by enlarging the field. This soil is moderately well suited to sewage lagoons because of seepage. Sealing the lagoon can help to control seepage.

The land capability classification is I, and the range site is Loamy Lowland.

### **Re—Reading silty clay loam, 0 to 2 percent slopes**

This very deep, nearly level, well drained soil is on high flood plains. It is subject to rare flooding. Individual areas are irregular in shape and range from 30 to 500 acres in size.

Typically, the surface layer is very dark grayish brown silty clay loam about 8 inches thick. The subsurface layer is dark grayish brown silty clay loam about 12 inches thick. The subsoil is firm silty clay loam about 40 inches thick. The upper part is dark grayish brown, and the lower part is yellowish brown and mottled.

Included with this soil in mapping are small areas of Kahola and Tully soils. The Kahola soils are silty and are adjacent to stream channels. The Tully soils contain more clay in the subsoil and are on more sloping areas on the adjoining uplands. Also included in some areas are short, sloping escarpments to the adjoining lower flood plain. Included soils make up about 15 percent of the map unit.

Permeability is moderately slow in the Reading soil. Surface runoff is slow. Available water capacity is high. Natural fertility is high. Organic matter content is moderate. The surface layer is friable and easily tilled throughout a wide range in moisture content. The shrink-swell potential is moderate.

Nearly all acreage is used for cultivated crops. This soil is well suited to wheat, grain sorghum, soybeans, and alfalfa. The main management concern is maintenance of fertility and tilth. Applying a system of conservation tillage that leaves all or part of the crop residue on the surface improves fertility and tilth and increases the rate of water infiltration. Crop rotations help to control weeds, plant diseases, and insects.

Grain sorghum, soybeans, and corn are the main irrigated crops. Using water efficiently and maintaining soil fertility are management concerns. Controlling the rate of water application helps to conserve irrigation water and lowers the cost of operation.

This soil is poorly suited to dwellings because of flooding. Dikes, levees, and other structures can reduce the hazard of flooding. Onsite inspection and knowledge of the flooding history of the area are needed when building sites are selected. This soil is

poorly suited to septic tank absorption fields because the moderately slow permeability of the subsoil restricts the absorption of effluent. It can be overcome by enlarging the field. This soil is moderately well suited to sewage lagoons because of seepage. Sealing the lagoon can help to control seepage.

The land capability classification is I, and the range site is Loamy Lowland.

### **Sa—Sarpy loamy fine sand, 0 to 4 percent slopes, occasionally flooded**

This very deep, undulating, excessively drained soil is on flood plains. Individual areas are irregular in shape and range from 20 to 160 acres in size.

Typically, the surface layer is grayish brown loamy fine sand about 9 inches thick. The substratum to a depth of about 60 inches is pale brown fine sand.

Included with this soil in mapping are small areas of the silty Eudora soils. Eudora soils are on nearly level, slightly lower areas. Included soils make up about 15 percent of the map unit.

Permeability is rapid in the Sarpy soil. Surface runoff is slow. Available water capacity is low. Natural fertility is low. Organic matter content is low. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Nearly all areas are used for range or wildlife habitat. The dominant native vegetation is little bluestem, big bluestem, and prairie sandreed. Overgrazed areas are dominated by annual weeds. Proper stocking rates, timely deferment of grazing, and uniform distribution of grazing help to keep the range in good condition.

Some areas of this soil have been used as a source of sand. Land smoothing and range seeding are needed to restore productivity in areas around abandoned sand pits.

These soils are generally unsuitable for building site development because of the flooding and seepage. Seepage from lagoons and septic tank absorption fields can contaminate ground water. Overcoming these hazards are difficult without major control measures.

The land capability classification is IVs, and the range site is Sandy Lowland.

### **Sc—Sarpy gravelly loamy sand, 0 to 4 percent slopes, occasionally flooded**

This very deep, undulating, excessively drained soil is on flood plains. Individual areas are irregular in shape and range from 20 to 80 acres in size.

Typically, the surface layer is very pale brown

gravelly loamy coarse sand about 14 inches thick. The substratum to a depth of about 60 inches is very pale brown. The upper part is sand, and the lower part is coarse sand.

Included with this soil in mapping are small areas of Eudora soils. The well drained, silty Eudora soils are on nearly level, slightly lower areas. Included soils make up about 10 percent of the map unit.

Permeability is rapid in the Sarpy soil. Surface runoff is slow. Available water capacity is low. Natural fertility is low. Organic matter content is low.

Most areas are used for range or wildlife habitat. The dominant native vegetation is little bluestem, big bluestem, and prairie sandreed. Overgrazed areas are dominated by annual weeds. Proper stocking rates, timely deferment of grazing, and uniform distribution of grazing help to keep the range in good condition.

Some areas of this soil have been used as a source of sand. Land smoothing and range seeding are needed to restore productivity in areas around abandoned sand pits.

This soil is generally unsuited for building site development because of flooding. Seepage from lagoons and septic tank absorption fields can contaminate ground water. Overcoming these hazards are difficult with major control measures.

The land capability classification is VIs, and the range site is Sandy Lowland.

### **Sh—Solomon silty clay, occasionally flooded**

This very deep, nearly level, poorly drained soil is in depressions and abandoned channels on flood plains. Slopes are 0 to 2 percent. Individual areas range from 150 to 800 feet wide and from 500 to more than 2,000 feet in length. They range from 5 to 175 acres in size.

Typically, the surface layer is very dark gray silty clay about 8 inches thick. The subsurface layer is dark gray silty clay about 11 inches thick. The subsoil to a depth of about 60 inches is very firm, mottled clay. The upper part is gray, and the lower part is grayish brown.

Included with this soil in mapping are small areas of McCook and Sutphen soils. The well drained McCook soils contain less clay in the subsoil than the Solomon soils and are in positions higher in the landscape than the Solomon soils. The moderately well drained Sutphen soils have carbonates below 15 inches from the surface. Sutphen soils are in positions on the landscape that are similar to those of the Solomon soils. Also included are better drained short, steep escarpments to the adjoining higher flood plains. Included soils make up about 15 percent of the map unit.

Permeability is very slow in the subsoil of the Solomon soil. Surface runoff is very slow. Available water capacity is moderate. Natural fertility is medium. Organic matter content is moderate. The surface layer is very firm and tilth is poor. This soil can be tilled only within a narrow range of moisture content. If tilled when too wet or too dry, clods form and structure is destroyed. The shrink-swell potential is high throughout the soil. A seasonal high water table is at the surface to 2 feet below the surface in the winter and the spring. Areas of this soil retain nearly all of the water that falls as rain and most areas receive additional water from adjacent areas. In many places ponding is frequent and the duration is brief to long.

About half of the acreage is used for cultivated crops. The rest is used as wildlife habitat. This soil is moderately well suited to grain sorghum, soybeans, and wheat. Flooding is a hazard if cultivated crops are grown. Wetness is a limitation in spring and early summer, and droughtiness is a limitation late in summer. Crop yields are reduced in some years because of flooding. In years with above average rainfall, wetness and flooding delay planting and harvesting, and cause some crop damage. Overcoming the flooding hazard is difficult without major flood control measures. Surface compacting is a problem if this soil is tilled when it is too wet. However, it can be minimized with timely tillage. The clayey surface and subsoil resist the movement of air, water, and roots and slowly releases water to growing plants. Applying a system of conservation tillage that leaves all or part of the crop residue on the surface improves fertility and tilth and increases the rate of water infiltration.

This soil is suitable for use as wildlife habitat. It provides habitat for many wildlife species, including waterfowl, deer, pheasants, and numerous songbirds. The wildlife population can be increased by planting small scattered patches of millet or grain sorghum.

This soil is generally unsuited to dwellings and septic tank absorption fields because of flooding, wetness, and shrink-swell potential. Also, it is unsuited to sewage lagoons because of flooding.

The land capability classification is IIIw, and the range site is Clay Lowland.

### **St—Sutphen silty clay, occasionally flooded**

This very deep, nearly level, moderately well drained soil is on flood plains along major rivers. Slopes are 0 to 1 percent. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is dark gray silty clay about 6 inches thick. The subsurface layer is dark gray

silty clay about 15 inches thick. The next layer is mixed dark gray and gray clay about 9 inches thick. The substratum to a depth of about 60 inches is very firm and mottled. The upper part is grayish brown clay, the next part is light brownish gray silty clay, and the lower part is grayish brown clay.

Included with this soil in mapping are small areas of McCook and Solomon soils. The well drained McCook soils are silty throughout and are on slightly higher landscapes. The poorly drained Solomon soils are calcareous to the surface and are on positions on the landscape similar to those of the Sutphen soils. Included soils make up about 20 percent of the map unit.

Permeability is very slow in the subsoil of the Sutphen soil. Surface runoff is slow. Available water capacity is moderate. Natural fertility is medium. Organic matter content is moderate. The surface layer is firm and tilth is poor. This soil can be tilled only within a narrow range of moisture content. If the soil is tilled when it is too wet or too dry, clods form and structure is destroyed. Shrink-swell potential is high.

Nearly all acreage is used for cultivated crops. This soil is moderately well suited to grain sorghum and wheat. Flooding is a hazard if cultivated crops are grown. Crop yields are reduced in some years because of flooding. In years of above average rainfall, wetness and flooding may delay planting and harvesting. Overcoming the flooding hazard is difficult without major flood control measures. Surface compacting is a problem if this soil is tilled when it is too wet. However, it can be minimized by timely tillage. The clayey surface and subsoil resist movement of air, water, and roots and slowly release water to growing plants. Applying a system of conservation tillage that leaves all or part of the crop residue on the surface improves fertility and tilth and increases the rate of water infiltration.

This soil is generally unsuited to dwellings and septic tank absorption fields because of flooding, wetness, and shrink-swell potential. Also, it is unsuited to sewage lagoons because of flooding.

The land capability classification is IIIw, and the range site is Clay Lowland.

### **Tn—Tully silty clay loam, 1 to 4 percent slopes**

This very deep, gently sloping, well drained soil is on side slopes and foot slopes. Individual areas are irregular in shape and range from 10 to 300 acres in size.

Typically, the surface layer is very dark brown silty clay loam about 7 inches thick. The subsurface layer is

very dark grayish brown silty clay loam about 6 inches thick. The subsoil is about 47 inches thick. The upper part is very dark grayish brown, firm silty clay; the next part is dark brown, firm, mottled silty clay; and the lower part is dark yellowish brown, firm, mottled silty clay. In some places the surface is a gravelly silty clay loam.

Included with this soil in mapping are small areas of Clime, Florence, Kahola, and Reading soils. The well drained Clime soils are 20 to 40 inches deep over shale. They occur on side slopes above the Tully soils. The well drained Florence soils contain many chert fragments in the subsoil. They occur on side slopes above the Tully soils. The silty Kahola soils are on flood plains below the Tully soils. The Reading soils contain less clay in the subsoil and are on adjoining high flood plains below the Tully soils.

Permeability is slow in the Tully soil. Surface runoff is medium. Available water capacity is moderate. Natural fertility is high. Organic matter content is moderate. The surface layer is friable and easily tilled throughout a wide range in moisture content. The shrink-swell potential is high.

About half of the acreage is used for cultivated crops. This soil is well suited to alfalfa, grain sorghum, soybeans, and wheat (fig. 8). Water erosion is a hazard if cultivated crops are grown. Terraces, grassed waterways, and contour farming help prevent excessive soil loss. A system of conservation tillage that leaves all or part of the crop residue on the surface improves fertility and tilth and increases the rate of water infiltration.

This soil is suited to range. The native vegetation is dominantly big bluestem, little bluestem, indiangrass, and switchgrass. In overgrazed areas, the less productive grasses such as tall dropseed and sideoats grama make up a larger percentage of the plant community. Water erosion is a hazard if range is overgrazed. In some areas gullies form along cattle trails. An adequate plant cover helps prevent excessive soil loss. Fencing and other means of controlling livestock traffic patterns can be used to prevent the formation of gullies and to give gullies time to revegetate. Proper stocking rates, a uniform distribution of grazing, and timely deferment of grazing and haying help keep the range in good condition. Early mowing of hay allows the plants to recover and store food before the first frost. Invasion of woody plants, such as eastern redcedar and Osage-orange, is a problem in some areas. Timely burning and proper use of chemicals help to control these plants.

This soil is poorly suited to dwellings and septic tank absorption fields. It is moderately well suited to sewage lagoons. The shrink-swell potential is a



Figure 8.—Soybeans grown on the contour in an area of Tully silty clay loam, 1 to 4 percent slopes.

limitation on sites for dwellings. Properly designing and reinforcing foundations, installing sealed foundation drains, and backfilling with suitable coarse textured material help to prevent structural damage caused by shrinking and swelling. The slow permeability restricts the absorption of effluent in the septic tank absorption fields. It can be overcome by enlarging the field. The slope is a limitation on sites for sewage lagoons. If the less sloping areas are selected as sites for lagoons, less leveling and banking will be needed during construction.

The land capability classification is IIe, and the range site is Loamy Upland.

### **To—Tully silty clay loam, 3 to 8 percent slopes**

This very deep, moderately sloping, well drained soil is on side slopes and foot slopes. Individual areas are irregular in shape and range from 10 to 300 acres in size.

Typically, the surface layer is very dark grayish brown silty clay loam about 12 inches thick. The subsoil is about 40 inches thick. The upper part is dark grayish brown, friable silty clay loam; the next part is brown, firm silty clay; and the lower part is brown, very firm silty clay. The substratum to a depth of 60 inches

is yellowish brown, firm silty clay. In some places the depth to shale bedrock is less than 60 inches. In most areas that are cultivated, erosion has thinned the surface layer and it is lighter in color and more clayey. In other places the surface is gravelly silty clay loam.

Included with this soil in mapping are small areas of Benfield, Clime, Florence, Kahola, and Reading soils. The moderately deep Benfield and Clime soil are on side slopes above the Tully soils. The well drained Florence soils contain many chert fragments in the subsoil. They occur on side slopes above the Tully soils. The silty Kahola soils are on flood plains below the Tully soils. The Reading soils contain less clay in the subsoil and are on high flood plains below the Tully soils. Also included are steep breaks adjacent to, and at the head slopes of, entrenched drainageways. Included soils make up about 15 percent of the map unit.

Permeability is slow in the Tully soil. Surface runoff is rapid. Available water capacity is moderate. Natural fertility is high. Organic matter content is moderate. The surface layer is friable and easily tilled throughout a wide range in moisture content. The shrink-swell potential is high.

Nearly all of the acreage is used as rangeland and native hay. The remaining acreage is used for cultivated crops. This soil is well suited to alfalfa, grain sorghum, soybeans, and wheat. Water erosion is a hazard if cultivated crops are grown. Terraces, grassed waterways, and contour farming help prevent excessive soil loss. A system of conservation tillage that leaves all or part of the crop residue on the surface improves fertility and tilth and increases the rate of water infiltration.

This soil is suited to range. The native vegetation is dominantly big bluestem, little bluestem, indiangrass, and switchgrass. In overgrazed areas, the less productive grasses such as tall dropseed and sideoats grama make up a larger percentage of the plant community. Water erosion is a hazard if range is overgrazed. In some areas gullies form along cattle trails. An adequate plant cover helps prevent excessive soil loss. Fencing and other means of controlling livestock traffic patterns can be used to prevent the formation of gullies and to give gullies time to revegetate. Proper stocking rates, a uniform distribution of grazing, and timely deferment of grazing and haying help keep the range in good condition. Suitable sites for stock-water ponds generally are available. Early mowing of hay allows the plants to recover and store food before the first frost. Invasion of woody plants, such as eastern redcedar and Osage-orange, is a problem in some areas. Timely burning and proper use of chemicals help to control these plants.

This soil is poorly suited to dwellings and septic tank absorption fields. It is moderately well suited to sewage lagoons. The shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations, installing sealed foundation drains, and backfilling with suitable coarse textured material help prevent structural damage caused by shrinking and swelling. The slow permeability restricts the absorption of effluent in the septic tank absorption fields. It can be overcome by enlarging the field. The slope is a limitation on sites for sewage lagoons. If the less sloping areas are selected as sites for lagoons, less leveling and banking will be needed during construction.

The land capability classification is IIIe, and the range site is Loamy Upland.

### **Vc—Valentine loamy fine sand, 5 to 15 percent slopes**

This very deep, rolling, excessively drained soil is on uplands. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface layer is grayish brown loamy fine sand about 5 inches thick. The substratum to a depth of about 60 inches is pale brown, loose, loamy sand in the upper part and sand in the lower part. In some places the surface layer is sandy loam.

Included with this soil in mapping are small areas of Clime, Ortello, Longford, and Wells soils. The moderately deep Clime soils formed in shale and are below the Valentine soils. The Ortello and Wells soils contain less sand throughout and are on positions in the landscape similar to those of the Valentine soils. The Longford soils contain more clay in the subsoil and are on gently sloping areas below the Valentine soils. Included soils make up about 15 percent of the map unit.

Permeability is rapid in the Valentine soil. Surface runoff is slow. Available water capacity is low. Natural fertility is low. Organic matter content is low.

Nearly all acreage is used as rangeland. Because of the hazard of soil blowing, droughtiness, and sandy surface layers, this soil is poorly suited to cultivated crops.

This soil is suited to range and tame grass pasture. The native vegetation is dominantly sand bluestem, little bluestem, indiangrass, and blue grama. Overgrazing causes deterioration of the plant community and increases the hazard of soil blowing. Under these conditions the more desirable grasses are replaced by less desirable grasses and by weeds. Proper stocking rates, a uniform distribution of grazing, and timely deferment of grazing helps keep the range

in good condition. Potential pond reservoir sites are limited on this soil. Application of fertilizer and timely mowing of tame grass increases the vigor, quality, and quantity of the grass plants.

This soil is moderately well suited to dwellings because of the slope. This soil is poorly suited to septic tank absorption fields and sewage lagoons because of seepage and the slope. Seepage from lagoons and septic tank absorption fields can contaminate shallow ground water. Sealing the lagoons helps to control seepage.

The land capability classification is VIe, and the range site is Sandy.

### **We—Wells-Ortello complex, 1 to 4 percent slopes**

These very deep, gently sloping, well drained soils are on undulating uplands. Wells soils make up about 55 percent of the map unit. The Ortello soils make up about 45 percent of the map unit. The Wells and Ortello soils are so intricately mixed on the landscape that it is not practical to separate them in mapping. The Wells soil is usually on the lower side slopes and the Ortello soil is on the upper slopes. Individual areas are irregular in shape and range from 10 to 250 acres in size.

Typically, the Wells soil has a surface layer of very dark grayish brown loam about 11 inches thick. The subsoil is friable and about 49 inches thick. The upper part is dark grayish brown and brown clay loam, the next part is brown sandy clay loam, and the lower part is light brown clay loam.

Typically, the Ortello soil has a surface layer of dark grayish brown sandy loam about 6 inches thick. The subsurface layer is dark grayish brown sandy loam about 9 inches thick. The subsoil is brown, friable sandy loam about 19 inches thick. The substratum to a depth of about 60 inches is light brown sandy loam.

Included with this soil in mapping are small areas of Clime, Crete, Longford, and Valentine soils. The moderately deep Clime soil is formed in calcareous shale and is on side slopes above the Wells and Ortello soils. The Crete soil contains more clay in the subsoil and is on slopes above the Wells and Ortello soils. The Longford soil contains more clay in the subsoil and is on similar positions in the landscape. Valentine soil contains more sand throughout and is in positions on the landscape similar to those of the Wells and Ortello soils. Included soils make up about 15 percent of the map unit.

Permeability is moderate in the Wells soil and moderately rapid in the Ortello soil. Surface runoff is medium in both soils. Available water capacity is high

in the Wells soil and moderate in the Ortello soil. Natural fertility is medium in both soils. Organic matter content is moderate in the Wells soil and moderately low in the Ortello soil. The surface layer of the Wells and Ortello soils is friable and can be easily tilled throughout a wide range in moisture content. Shrink-swell potential in the subsoil is moderate in the Wells soil is moderate and low in the Ortello soil.

Most of the acreage is used for cultivated crops. These soils are well suited to wheat, grain sorghum, soybeans, and alfalfa. Water erosion is a hazard if cultivated crops are grown. Terraces, grassed waterways, and contour farming help prevent excessive soil loss. A system of conservation tillage that leaves all or part of the crop residue on the surface improves fertility and tilth and increases the rate of water infiltration.

These soils are suited to range and tame grass pasture. The native vegetation is dominantly big bluestem, little bluestem, and indiangrass. Overgrazing reduces plant cover and causes deterioration of the plant community. Under these conditions the more desirable grasses are replaced by less desirable grasses and weeds. Proper stocking rates, a uniform grazing distribution, and timely deferment of grazing help keep the range in good condition. Brush and trees have invaded some areas. Controlled burning in the spring, proper use of chemicals, and selective cutting help to control woody plants. Application of fertilizer and timely mowing of tame grass pasture increases plant vigor and quality and quantity of forage.

Wells soil is moderately well suited to dwellings and sewage lagoons. It is well suited to septic tank absorption fields. Shrink-swell potential in the subsoil is a limitation on sites for dwellings. Properly designing and reinforcing foundations, installing sealed foundation drains, and backfilling with suitable coarse textured material help to prevent structural damage caused by shrinking and swelling. Seepage and the slope are limitations on sites for sewage lagoons. Sealing the lagoon helps reduce seepage. If the less sloping areas are selected as sites for lagoons, less leveling and banking will be needed during construction. Ortello soil is well suited to dwellings and is generally unsuited for septic tank absorption fields and sewage lagoons because of seepage. Overcoming this hazard is difficult without major control measures.

The land capability classification is IIIe, and the range site is Loamy Upland for the Wells soil and Sandy for the Ortello soil.

### **Wf—Wells-Ortello complex, 4 to 8 percent slopes**

These very deep, moderately sloping, well drained soils are on undulating uplands. Individual areas are irregular in shape and range from 10 to 200 acres in size. They are about 50 percent Wells soil and about 30 percent Ortello soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is impractical.

Typically, the Wells soil has a surface layer of very dark grayish brown loam about 12 inches thick. The subsoil is friable and about 51 inches thick. In sequence downward, it is dark grayish brown clay loam, brown clay loam, brown sandy clay loam, and light brown clay loam.

Typically, the Ortello soil has a surface layer of very dark grayish brown fine sandy loam about 6 inches thick. The subsoil is about 40 inches thick. The upper part is very dark grayish brown, friable fine sandy loam, and the lower part is dark grayish brown, friable fine sandy loam. The substratum to a depth of about 60 inches is yellowish brown loamy sand.

Included with these soils in mapping are small areas of Clime and Longford soils. The moderately deep Clime soil formed in calcareous shales. It is on side slopes below the Wells and Ortello soils. The Longford soil contains more clay in the subsoil than the Wells and Ortello soils. It is in the less sloping areas below the Wells and Ortello soils. Included soils make up about 15 percent of the map unit.

Permeability is moderate in the Wells soil and moderately rapid in the Ortello soil. Surface runoff is medium in both soils. Available water capacity is high in the Wells soil and moderate in the Ortello soil. Natural fertility is medium in both soils. Organic matter content is moderate in the Wells soil and moderately low in the Ortello soil. The surface layer of the Wells and Ortello soils is friable and can be easily tilled throughout a wide range in moisture content. Shrink-swell potential in the subsoil is moderate in the Wells soil and low in the Ortello soil.

About 60 percent of the acreage is used for cropland. These soils are well suited to wheat, grain sorghum, soybeans, and alfalfa. Water erosion is a hazard if cultivated crops are grown. Terraces, grassed waterways, and contour farming help prevent excessive soil loss. A system of conservation tillage that leaves all or part of the crop residue on the surface improves fertility and tilth and increases the rate of water infiltration.

These soils are suited to rangeland and tame grass pasture. The native vegetation is dominantly big bluestem, little bluestem, and indiagrass. Overgrazing reduces plant cover and causes deterioration of the plant community. Under these conditions, the more desirable grasses are replaced by less desirable

grasses and weeds. Proper stocking rates, a uniform grazing distribution, and timely deferment of grazing help keep the grass in good condition. Brush and trees have invaded into some areas. Timely burning, proper use of chemicals, and selective cutting help to control these plants. Application of fertilizer and timely mowing of tame grass increase plant vigor, quality, and quantity.

Wells soil is moderately well suited to dwellings and sewage lagoons. It is well suited to septic tank absorption fields. Shrink-swell potential in the subsoil is a limitation on sites for dwellings. Properly designing and reinforcing foundations, installing sealed foundation drains, and backfilling with suitable coarse textured material help to prevent structural damage caused by shrinking and swelling. Seepage and slope are limitations on sites for sewage lagoons. Sealing the lagoon helps reduce seepage. If the less sloping areas are selected as sites for lagoons, less leveling and banking will be needed during construction. Ortello soil is well suited to dwellings and is generally unsuited for septic tank absorption fields and sewage lagoons because of seepage. Overcoming this hazard is difficult without major control measures.

The land capability classification is IVE, and the range site is Loamy Upland for the Wells soil and Sandy for the Ortello soil.

## Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban or built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal expenditure of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The

temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Natural Resources Conservation Service.

About 116,670 acres in Geary County, or about 43 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county, but most are in associations 3, 4, 6, 7 and 8, which are described under the heading "General Soil Map Units." About 70,000 acres of this prime farmland is used for crops. The crops grown on this land are mainly wheat and grain sorghum.

A recent trend in land use in some parts of the

county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table qualify as prime farmland only in areas where this limitation has been overcome by drainage measures. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not this limitation has been overcome by corrective measures.

# Use and Management of the Soils

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This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help to prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreational facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

## Crops and Pasture

Jerry B. Lee, conservation agronomist, Natural Resources Conservation Service, helped prepare this section.

General management needed for crops and pasture

is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Natural Resources Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under the heading "Detailed Soil Map Units." Specific information can be obtained from the local office of the Natural Resources Conservation Service or the Cooperative Extension Service.

About 75,000 acres in Geary County, or 30 percent of the total acreage, is used for cultivated crops. During the period 1980 to 1990, wheat was grown on about 36 percent of the cropland; grain sorghum on 15 percent; soybeans on 7 percent; and alfalfa, tame hay, and other miscellaneous crops on 31 percent (6). About 11 percent of the cropland was summer fallowed. The acreage used for soybeans increased during this period compared to that of the previous 10-year period. The acreage of all other crops remained about the same.

Crop production can be increased on most farms by applying the latest technology. This soil survey can facilitate the application of such technology. The main concerns in managing the soils in Geary County for cultivated crops are controlling erosion, conserving or increasing the moisture supply in the soils, and maintaining fertility and tilth.

Water erosion is the major hazard on about 20 percent of the cropland. It occurs mainly on soils that have a slope of 2 percent or more. Examples are Crete, Geary, Holder, Konza, and Longford soils.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils that have a clayey subsoil such as Crete, Konza, and Ladysmith soils. Secondly, erosion pollutes streams with sediments, nutrients, and pesticides. Control of erosion minimizes the pollution of streams and improves the quality of water.

Erosion-control practices provide a protective cover, reduce the runoff rate, and increase the rate of water infiltration. A cropping system that keeps a plant cover on the surface for extended periods helps to control sheet and rill erosion and preserves the productive capacity of the soils.

Conservation tillage and conservation cropping systems help to control sheet and rill erosion. A system of conservation tillage leaves all or part of the crop residue on the surface. Examples are no-till, ridge-till, and mulch-till. When these practices are applied, the crop residue is left to provide a protective cover before and during the preparation of a seedbed and at least a partial cover for the succeeding crop. Drilled crops, such as small grain, are alternated with row crops in a conservation cropping sequence.

Terraces, diversions, grassed waterways, and contour farming are needed in combination with conservation tillage on soils that have a slope of more than 2 percent. If a system of conservation tillage is not applied, they also are needed on soils that have a slope of more than 1 percent. Terraces and diversions help to control erosion by shortening the length of slopes and reducing the runoff rate. They are most practical on deep, well drained soils that have uniform slopes. Contour farming should generally be used in combination with terraces. It is best suited to soils that have smooth, uniform slopes and are suitable for terracing.

Inadequate rainfall in some years is a problem on all of the cropland in the county. As a result, the supply of water stored in the soils should be conserved or increased by residue management and terracing.

Organic matter is a storehouse of available plant nutrients. It increases the rate of water intake, helps to prevent surface crusting, helps to control erosion, and promotes good tilth. About half of the cropland in the county occurs as soils that have a silt loam surface layer. During periods of intensive rainfall, a crust forms at the surface. When dry, the crusted surface becomes nearly impervious to water. As a result, the runoff rate is increased. Regularly adding organic material and leaving crop residue on the surface help to prevent excessive crusting, increase the rate of water infiltration, and reduce the runoff rate and the hazard of erosion.

Plants on most of the arable soils in the county respond well to applications of nitrate and phosphate fertilizer. On all soils the amount of fertilizer to be applied should be based on the results of soil tests, on the needs of the crop, on the expected level of yields, and on the experience of farmers. The Cooperative Extension Service can help to determine the kind and amount of fertilizer needed.

Information about the design of erosion-control practices is available in the local office of the Natural Resources Conservation Service. The latest information about growing crops can be obtained from the Cooperative Extension Service or the Natural Resources Conservation Service.

### **Yields per Acre**

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Natural Resources Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

### **Land Capability Classification**

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to

management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, or for engineering purposes.

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit. Only class and subclass are used in this survey.

*Capability classes*, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

*Capability subclasses* are soil groups within one class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to

pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of the map units in this survey area is given in the section “Detailed Soil Map Units” and in the yields table.

## Rangeland

Michael S. Meurisse, range conservationist, Natural Resources Conservation Service, helped prepare this section.

About 113,000 acres in Geary County or 44 percent of the total acreage is rangeland. Most of the rangeland is too steep or too rocky for cultivation. Cow-calf operations are the dominant livestock users of the county's rangeland, but yearling stock or operations are also common.

Some livestock producers use cool season pastures, principally brome grass, to extend the grazing season. Grain sorghum crop residue is commonly used as a supplemental forage in cow-calf operations. During winter, protein concentrates are used to supplement low-quality, dormant forages. During most winters, hay is fed for short periods when native grass pastures are covered with snow.

Soils strongly influence the potential plant community in any given area within the county. The soils and climate of the county generally support a tall-grass prairie natural plant community, dominated by bluestems, indiangrass, and switchgrass. However, some of the steep, shallow soils are only capable of supporting a mixture of plants that is similar to the mixed prairie of central Kansas.

Naturally occurring fires played a major role in development of these plant communities. In areas where fire has been excluded, productivity of the rangeland has been reduced by brush invasion. Controlled burning is used extensively as a management tool in Geary County to reduce brush invasion, improve grazing distribution, and to improve weight gain of yearling cattle.

While most of the rangeland in the county has been well managed, forage production has been reduced in some areas by overgrazing. Because of rough topography, portions of a pasture are often overgrazed, while other areas may be under used. Spring developments, ponds, proper location of salt, fencing, and controlled burning can help to improve grazing distribution. These measures help to maintain or improve range condition when combined with proper grazing use, timely deferment of grazing, planned grazing systems, brush management, and reseeding of marginal cropland or depleted rangeland.

In areas that have similar climate and topography, differences in the kind and amount of vegetation

produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 7 shows, for nearly all the soils in the survey area, the range site and the total annual production of vegetation in favorable, average, and unfavorable years. Only those soils that are used as rangeland or are suited to use as rangeland are listed. An explanation of the column headings in table 7 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

*Potential annual production* is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, average, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, control of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat

below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

The soils in the survey area are assigned to the following range sites: Clay Lowland, Claypan, Clay Upland, Limy Upland, Loamy Lowland, Loamy Terrace, Loamy Upland, Sandy, Sandy Lowland, and Shallow Limy. These sites are described in the paragraphs that follow.

**Clay Lowland range site.** The soils in this range site are on flood plains and terraces and are occasionally flooded.

The potential native vegetation on this site is a tall grass prairie. Typically, the dominant grasses are prairie cordgrass, which makes up about 45 percent of the vegetation; big bluestem, 10 percent; indiangrass, 5 percent; switchgrass, 10 percent; and eastern gamagrass, 5 percent. Other grasses and grasslike plants are tall dropseed, Canada wildrye, green muhly, Florida paspalum, scouringrush, and sedges. Forbs, such as American licorice, Illinois bundleflower, Maximilian sunflower, wholeleaf rosinweed, tall goldenrod, and Baldwin ironweed make up about 10 percent of the vegetation. Woody plants, such as green ash, hackberry, buckbrush, indigobush, and cottonwood may be present in small amounts on this site.

Because of the extra moisture and deeper rooted plants, this site is a preferred grazing area, especially during plant stress periods. Overgrazing reduces the production of big bluestem, prairie cordgrass, indiangrass, switchgrass, and eastern gamagrass. The amount of palatable forbs, such as American licorice, Illinois bundleflower, and Maximilian sunflower, is also reduced. Tall dropseed, Baldwin ironweed, and buckbrush are the principal increasers.

Where overgrazing has continued for a few years, the site can often be returned to near its potential by management that includes proper grazing use and a scheduled deferment of grazing during the growing season. If the site has been overgrazed for a long period, recovery may be slow even when good management is applied. Under these conditions, tall dropseed, Kentucky bluegrass, Japanese brome, Baldwin ironweed, buckbrush, and giant ragweed dominate the understory. In the absence of fire, the woody overstory vegetation will dominate the site.

**Clay Upland range site.** The soils in this range site are on uplands.

The potential native vegetation on this site is a tall grass prairie. Typically, the dominant grasses are big bluestem, which makes up about 30 percent of the vegetation; little bluestem, 20 percent; switchgrass, 15

percent; indiangrass, 15 percent; and tall dropseed, 5 percent. Other grasses are porcupinegrass, western wheatgrass, blue grama, buffalograss, prairie junegrass, purple lovegrass, Canada wildrye, sideoats grama, and rosette panicum. Sedges are also usually present in small amounts. Forbs, such as catclaw sensitivebrier, pitcher sage, compassplant, American licorice, Louisiana sagewort, Illinois bundleflower, slimflower scurfpea, dotted gayfeather, goldenrods, and western ragweed make up about 10 percent of the vegetation. Leadplant is common on this site, but generally in small amounts.

Initial overgrazing on this site generally reduces the production of big bluestem, indiangrass, and little bluestem. Switchgrass is reduced if overgrazing occurs during the first half of the growing season. Tall dropseed is the major increaser with overgrazing. After periods of continued overgrazing, tall dropseed, sideoats grama, broomweed, western ragweed, buffalograss, and western wheatgrass become the dominant species. Remnants of the preferred grass species will tend to survive in a very reduced condition unless destructive grazing occurs.

When most of the taller species are removed from the site through grazing pressure and dry weather cycles, returning the site to its potential native vegetation is extremely difficult and may take several decades. Proper stocking rates, timely deferment of grazing, and uniform distribution of grazing help to keep the range in good condition. Where trees and brush have invaded, brush control is needed to improve forage production. Controlled burning in late spring helps to control woody plants. The proper use of chemical sprays and selective cutting also helps to control woody plants.

**Claypan range site.** The soils in this range site are on nearly level to gently sloping uplands.

The potential native vegetation on this site is mixed prairie. Typically, the dominant grasses are big bluestem, which makes up about 15 percent of the vegetation; little bluestem, 15 percent; sideoats grama, 15 percent; switchgrass, 15 percent; western wheatgrass, 10 percent; indiangrass, 5 percent; and tall dropseed, 5 percent. Other grasses are blue grama, buffalograss, rosette panicum, and purple lovegrass. Rushes and sedges generally grow on this site. Forbs, such as dotted gayfeather, heath aster, slimflower scurfpea, Missouri goldenrod, western ragweed, and Louisiana sagewort, make up about 10 percent of the vegetation.

Overgrazing on this site generally reduces the production of big bluestem, little bluestem, indiangrass, and switchgrass. Tall dropseed, western wheatgrass,

and buffalograss are the primary increasers. In severely overused areas Japanese brome, prairie threeawn, windmillgrass, buffalograss, and broomweed become the dominant species.

This site is frequently overgrazed because of its accessibility and the influence of sodium on the vegetation. A system of grazing that includes a scheduled deferment of grazing during the growing season can help to restore this site if overgrazing has not been severe. The vegetation improves slowly, however, compared to other range sites in the county.

**Limy Upland range site.** The soils in this range site are on gently sloping to steep uplands.

The potential native vegetation on this site is tall grass prairie. Typically, the dominant grasses are big bluestem, which makes up about 35 percent of the vegetation; little bluestem, 20 percent; sideoats grama, 10 percent; indiangrass, 5 percent; and switchgrass, 5 percent. Other grasses are blue grama, buffalograss, plains muhly, and hairy grama. Forbs, such as blacksamson, catclaw sensitivebrier, dotted gayfeather, heath aster, purple prairie-clover, prairie coneflower, Missouri evening primrose, manyflower scurfpea, and western ragweed, make up about 15 percent of the vegetation. Leadplant, ceanothus, prairie rose, roughleaf dogwood, smooth sumac, and aromatic sumac grow in small amounts.

In overgrazed areas big bluestem, little bluestem, indiangrass, and switchgrass are the major decreaseers. Sideoats grama, hairy grama, Missouri goldenrod, Louisiana sagewort, heath aster, western ragweed, smooth sumac, and roughleaf dogwood the are principal increasers. In severely overgrazed areas blue grama, buffalograss, Japanese brome, Kentucky bluegrass, smooth sumac, roughleaf dogwood, buckbrush, Osage-orange, and eastern redcedar become the dominant vegetation.

In the steeper, less accessible areas, the preferred grass species generally are not excessively grazed. These areas help to provide seed sources for the better forage plants after long periods of drought or overgrazing, or both. Grazing distribution is a problem because the livestock prefer the more gently sloping areas. Measures that distribute the grazing evenly, proper stocking rates, prescribed burning, and a scheduled deferment of grazing during the growing season help to restore this site to its production potential. Properly located salting and watering facilities help to achieve an even distribution of grazing. Other management techniques, such as proper fence location and a planned grazing system, also are beneficial.

Where trees and brush have invaded, brush control



**Figure 9.**—An area of Clime-Sogn silty clay loams, 5 to 20 percent slopes, where brush and trees have invaded. This unit is in the Limy Upland range site.

is needed to improve forage production (fig. 9). Controlled burning in late spring helps to control woody plants. The proper use of chemical sprays and selective cutting also help to control woody plants.

**Loamy Upland range site.** The soils in this range site are on uplands.

The potential native vegetation on this site is tall grass prairie. Typically, the dominant grasses are big bluestem, which makes up about 35 percent of the vegetation; little bluestem, 20 percent; indiangrass, 10 percent; switchgrass, 10 percent; and eastern gamagrass, 10 percent. Other grasses are prairie junegrass, sideoats grama, tall dropseed, Canada wildrye, blue grama, and Scribner panicum. Forbs, such as catclaw sensitivebrier, Illinois bundleflower,

purple prairie-clover, dotted gayfeather, compassplant, heath aster, and pitcher sage, make up about 10 percent of the vegetation. Leadplant is common on this site but generally in small amounts.

Initial overgrazing of this site generally reduces the production of big bluestem, indiangrass, switchgrass and preferred forbs. Under these conditions, little bluestem, sideoats grama, tall dropseed, buffalograss, blue grama, and western ragweed increase in abundance. After periods of continued overgrazing, tall dropseed, western ragweed, Kentucky bluegrass, buckbrush, and redcedar become the dominant species.

When most of the taller species are removed from the site through grazing pressure and dry weather cycles, returning the site to its potential native

vegetation is extremely difficult. Where remnant stands of the taller species are evident, the site can be returned to its production potential by proper stocking rates and a system of grazing that includes a scheduled deferment of grazing during the growing season.

**Loamy Lowland range site.** The soils in this range site are on flood plains and terraces and are rarely or occasionally flooded.

The potential native vegetation on this site is tall grass prairie. Typically, the dominant grasses are big bluestem, which makes up about 40 percent of the vegetation; eastern gamagrass, 15 percent; indiangrass, 10 percent; prairie cordgrass, 5 percent; and switchgrass, 10 percent. Other grasses are Florida paspalum, green muhly, tall dropseed, prairie junegrass, Canada wildrye, and knotroot bristlegrass. Forbs, such as American licorice, compassplant, Illinois bundleflower, Maximilian sunflower, sawtooth sunflower, Baldwin ironweed, Louisiana sagewort, and western ragweed, make up 10 percent of the vegetation. Black walnut, bur oak, hackberry, indigobush, and elderberry make up about 5 percent.

Because of the extra moisture and deeper rooted plants, this site is a preferred grazing area, especially during plant stress periods. Overgrazing reduces the production of big bluestem, eastern gamagrass, indiangrass, and switchgrass. The amount of palatable forbs, such as American licorice, compassplant, Illinois bundleflower, and Maximilian sunflower, is also reduced. Tall dropseed, Baldwin ironweed, western ragweed, and buckbrush are the principal increasers.

Where overgrazing has continued for a few years, the site can often be nearly returned to its potential by management that includes proper grazing use and a scheduled deferment of grazing during the growing season. If the site has been overgrazed for a long period, recovery may be slow even when good management is applied. Under these conditions, tall dropseed, western ragweed, and undesirable woody species become the dominant vegetation. If fire is excluded, this site often becomes dominated by tree species.

**Loamy Terrace range site.** The soils in this range site are on nearly level stream terraces and are subject to rare flooding.

The potential native vegetation on this site is tall grass prairie. Typically, the dominant grasses are big bluestem, which makes up about 35 percent of the vegetation; switchgrass, 10 percent; little bluestem, 10 percent; indiangrass, 10 percent; western wheatgrass, 5 percent; and sideoats grama, 5 percent. Other

grasses are Canada wildrye, blue grama, rosette panicum, tall dropseed, and western wheatgrass. Sedges are usually present in amounts up to 5 percent. Forbs, such as American licorice, aromatic aster, catclaw sensitivebrier, heath aster, Illinois bundleflower, Louisiana sagewort, pitcher sage, slimflower scurfspea, and western ragweed, make up about 5 percent of the vegetation. Small amounts of American plum and buckbrush are common.

This site is generally grazed along with larger areas of upland range sites. Because of the combination of sites, the careful use of management practices, such as fencing and the proper location of water, salt, minerals, and feeding areas, are needed to achieve an adequate distribution of grazing. After periods of continued excessive use, the amount of big bluestem, little bluestem, switchgrass, and eastern gamagrass decreases. Long-term overgrazing may remove these species from the site. Western wheatgrass and sideoats grama are the major increasers on this site, along with forbs, blue grama, and tall dropseed. Returning a continuously overgrazed area to its original productivity is difficult. In areas where remnant stands of the taller grasses are evident, proper stocking rates and periodic deferment of grazing or a planned grazing system help to nearly return the site to its potential. These practices also help to improve or maintain the site at any stage of productivity.

**Sandy Lowland range site.** The soils in this range site are occasionally flooded and are on flood plains adjacent to stream channels.

The potential native vegetation of this site is tall grass prairie and sparse to dense stands of bottomland timber. Typically, the dominant grasses are sand bluestem, which makes up about 30 percent of the vegetation; little bluestem, 15 percent; indiangrass, 10 percent; switchgrass, 10 percent; and eastern gamagrass, 5 percent. Other grasses are prairie sandreed, Canada wildrye, sand lovegrass, porcupinegrass, western wheatgrass, purpletop, sand paspalum, and tall dropseed. Forbs such as catclaw sensitivebrier, woolly verbena, Illinois bundleflower, Maximilian sunflower, Louisiana sagewort, and western ragweed make up about 10 percent of the vegetation. Woody plants, such as cottonwood, hackberry, green ash, poison ivy, black willow, and American plum make up about 15 percent.

Initial overgrazing on this site reduces the production of the sand bluestem, indiangrass, switchgrass, and eastern gamagrass. As the production of these species decreases, the amount of purpletop, sand paspalum, and others increases. If

overgrazing continues, and fire is excluded, a large increase in the tree and shrub population is likely.

When most of the taller species are removed from the site through grazing pressure and dry weather cycles, restoring the potential native vegetation is difficult. Where remnants of the taller species are evident, management that includes proper stocking rates and a scheduled deferment of grazing during the growing season is effective in nearly restoring the site to its potential. When trees and shrubs dominate the site, it is nearly impossible to return the site to herbaceous vegetation without a complete clearing operation.

**Sandy range site.** The soils in this range site are on uplands.

The potential native vegetation on this site is mixed prairie grasses. Typically, the dominant grasses are sand bluestem, which makes up about 40 percent of the vegetation; little bluestem, 20 percent; switchgrass, 10 percent; indiangrass, 5 percent; porcupinegrass, 5 percent; sideoats grama, 5 percent; and blue grama, 5 percent. Other grasses are Canada wildrye, sand dropseed, tall dropseed, hairy grama, windmillgrass, sand paspalum, and Scribner panicum. Forbs such as Louisiana sagewort, poppymallow, slimflower scurfpea, upright prairie coneflower, western ragweed, and yarrow make up about 5 percent of the vegetation. Chickasaw plum, prairie rose, small soapweed, and American plum make up about 5 percent.

This site generally is a highly preferred grazing area. Because of past grazing management, it is generally more deteriorated than most of the adjacent sites. Overgrazing rapidly reduces the production of big or sand bluestem. Sand bluestem is generally replaced by little bluestem, sideoats grama, blue grama, and sand dropseed. If overgrazing continues, the amount of little bluestem and switchgrass is reduced. After long periods of severe overgrazing, the site is dominated by sand dropseed, sand paspalum, annual grasses, unpalatable forbs, and woody species.

Management that includes proper grazing use and a scheduled deferment of grazing during the growing season maintains this site in a productive condition. Also, it can restore overgrazed areas to their original production potential if remnants of the original species are evident. Reseeding may be needed on sites where the more desirable mid and tall grasses have been removed.

**Shallow Limy range site.** The soils in this range site are on gently sloping to steep uplands.

The potential native vegetation on this site is mixed grass prairie. Typically, the dominant grasses are big

bluestem, which makes up about 25 percent of the vegetation; little bluestem, 20 percent; sideoats grama, 20 percent; indiangrass, 10 percent; and switchgrass, 5 percent. Other grasses are blue grama, hairy grama, green muhly, buffalograss, tall dropseed, and rosette panicum. Forbs such as blacksamson, catclaw sensitivebrier, dotted gayfeather, purple prairie-clover, Missouri evening primrose, nettleleaf noseburn, and western ragweed make up about 15 percent of the vegetation. Aromatic sumac, buckbrush, ceanothus, leadplant, pricklypear, and smooth sumac may make up about 5 percent of the vegetation on this site.

In overgrazed areas big bluestem, little bluestem, and indiangrass are the major decreasers. Sideoats grama, blue grama, buffalograss, and hairy grama are principal increasers. In severely overgrazed areas hairy grama, annual grasses, unpalatable forbs, and smooth sumac become the dominant vegetation.

This site is often grazed more heavily than adjoining sites, especially in summer. Cattle prefer the shorter plant growth on this site, as well as the cooling summer winds which generally cross these areas. This site generally occurs in narrow bands across the slopes. If the adjoining sites have not been overgrazed, they provide a source of desirable plants to recolonize the site when management is improved. Grazing management that provides improved grazing distribution, proper stocking rates, and a scheduled deferment of grazing during the growing season help to restore this site to its potential. Properly locating salting and watering facilities help to distribute grazing. Other management techniques, such as proper fence location, planned grazing systems, and prescribed burning are also beneficial.

## Native Woodland, Windbreaks, and Environmental Plantings

Gary A. Kuhn, forester, Natural Resources Conservation Service, helped prepare this section.

Native woodland in Geary County occurs on the bottom land along rivers and streams, in upland drainageways, and on steep breaks. Approximately 18,600 acres, or 8 percent of the county, is considered forest land suitable for commercial production of wood products.

The most productive woodlands are found on deep well-drained loamy soils near the major rivers and streams. Soils in these areas are the Kahola, Eudora, Reading, and Haynie. Important trees on these soils include eastern cottonwood, hackberry, black walnut, green ash, honeylocust, basswood, bur oak, American sycamore, red (slippery) elm, American elm, boxelder, and silver maple. Flooding frequency on these soils

affects woodland suitability and productivity. Kahola, Eudora, and Reading soils are flooded less frequently than the Haynie soil and can be managed for production of black walnut, bur oak, and hackberry. Eastern cottonwood and green ash are more common on the Haynie soils. Most of these soils are in crop production; however, the remaining stands of timber adjacent to cropland have good potential to produce quality wood products if some forest management practices are applied. Also, cropland acres on these soils provide excellent sites for timber, firewood, or Christmas tree plantings.

Sarpy soils are also found on bottom land next to rivers. These soils are sandy textured and drier than the loamy bottomland soils. Common trees found on these soils include eastern cottonwood, red elm, boxelder, green ash, American sycamore, basswood, hackberry, and honeylocust.

The Clime and Tully soils are on upland side slopes. The Clime soils occur on the steep side slopes in association with the Ft. Riley limestone. In wooded areas the vegetation consists mainly of poor-quality chinkapin oak. The use and management of this soil is best left for range, watershed protection, or wildlife habitat. The Tully soils occur on the lower foot slopes along upland drainageways. Wooded areas have fair stands of bur oak, hackberry, and green ash. This soil has good potential for production of firewood and wildlife habitat with some limited timber harvesting possible.

Most farmsteads and ranch headquarters in Geary County are protected by windbreaks. Eastern redcedar and Siberian elm are the most common species in these windbreaks. Other species that occur include green ash, honeylocust, eastern cottonwood, hackberry, scotch pine, Austrian pine, and ponderosa pine. Many windbreaks that are more than 30 years old need renovation.

In order for windbreaks to fulfill their intended purpose, the trees and shrubs selected for planting should be suited to the soils. Selecting suitable species helps to ensure survival and maximum growth rate. Permeability, available water capacity, fertility, soil depth, and soil texture greatly affect the growth rate.

Trees and shrubs generally can be easily established in Geary County. The survival rate can be reduced mainly by competition from weeds and grasses and by dry conditions. The main management needs are proper site preparation before the trees or shrubs are planted and measures that control competing vegetation after planting. Supplemental watering may be needed during dry periods.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and

gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Natural Resources Conservation Service or the Cooperative Extension Service or from a commercial nursery.

## Recreation

Ken Kuiper, biologist, Natural Resources Conservation Service, helped prepare this section.

Geary County has several areas of scenic, geologic, and historic interest. These areas provide a variety of public outdoor recreation and educational opportunities.

The Fort Riley limestone formation is a massive rock layer that is responsible for the geologic development of the second largest remaining, contiguous native rangeland in the world called the Flint Hills. Travelers enjoy the rugged beauty of the region that is characterized by scenic, unbroken rangeland and clean, meandering streams.

Camping, fishing, boating, picnicking, swimming, and hunting are found on thousands of acres of lakes, streams, rivers, and public wildlife areas. Geary County State Lake and Milford Lake (fig. 10) are the two large public areas with a state fish hatchery and conservation education center located below Milford Dam.

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered.



Figure 10.—An area of Holder silt loam, 3 to 7 percent slopes, near Millford Lake.

Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that

soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

*Camp areas* require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders

can greatly increase the cost of constructing campsites.

*Picnic areas* are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

*Playgrounds* require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

*Paths and trails* for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

## Wildlife Habitat

Ken Kuiper, biologist, Natural Resources Conservation Service, helped prepare this section.

The Geary County ecosystem supports both terrestrial and aquatic game and nongame fish and wildlife. These species depend on a diversity of suitable habitat that is part of the natural environment. Each population survives on habitat elements that include soil, water, and plants. This section provides basic soil information related to planning, applying, and maintaining habitat for wildlife.

Big game species provide unique hunting opportunities for sportsmen. Turkey and deer found throughout the area are closely associated with riparian habitat. Fort Riley Military Reservation contains a resident population of Elk that is presently one of two hunted herds in Kansas.

Small game species include bobwhite quail, ring-necked pheasant, cottontail rabbit, prairie chicken, and fox squirrel. Migratory game birds that periodically use the county are dove, geese, and ducks. Interest in furbearers is influenced by international supply and demand. Species include raccoon, coyote, opossum, beaver, muskrat, mink, and striped skunk.

Nongame species are important to the public and wildlife-oriented organizations. The bald eagle and other raptors, song birds, shore birds, reptiles, amphibians, and fish are watched, studied, and collected. Species

considered threatened and endangered are protected by state and federal statutes. Critical habitat for threatened and endangered species is also protected by statute.

Milford Reservoir and numerous small lakes provide water-based recreation as well as water supply. Largemouth bass, walleye, white bass, bluegill, crappie, and catfish are commonly caught by anglers.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

*Grain and seed crops* are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

*Grasses and legumes* are domestic perennial

grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, bromegrass, clover, and alfalfa.

*Wild herbaceous plants* are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and grama.

*Hardwood trees* and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, poplar, cherry, sweetgum, apple, hawthorn, dogwood, hickory, blackberry, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

*Coniferous plants* furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

*Shrubs* are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are mountainmahogany, bitterbrush, snowberry, and big sagebrush.

*Wetland plants* are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, saltgrass, cordgrass, rushes, sedges, and reeds.

*Shallow water areas* have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples

of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

*Habitat for openland wildlife* consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include bobwhite quail, pheasant, meadowlark, field sparrow, cottontail, and red fox.

*Habitat for woodland wildlife* consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, gray fox, raccoon, deer, and bear.

*Habitat for wetland wildlife* consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

*Habitat for rangeland wildlife* consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include antelope, deer, sage grouse, meadowlark, and lark bunting.

## Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

*Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.*

*The information is not site specific and does not eliminate the need for onsite investigation of the soil or for testing and analysis by personnel experienced in the design and construction of engineering works.*

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this

section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

### **Building Site Development**

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction

costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

*Shallow excavations* are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

*Dwellings and small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

*Local roads and streets* have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

### **Sanitary Facilities**

Table 12 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the

indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

*Septic tank absorption fields* are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

*Sewage lagoons* are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features,

and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

*Sanitary landfills* are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

*Daily cover for landfill* is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as the final cover for a landfill should be suitable for

plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

### Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good*, *fair*, or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

*Roadfill* is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of less than 1

foot. They may have layers of suitable material, but the material is less than 3 feet thick.

*Sand* and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

*Topsoil* is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less

than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

### Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

*Pond reservoir areas* hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

*Embankments, dikes, and levees* are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to

seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

*Drainage* is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, and sulfur. Availability of drainage outlets is not considered in the ratings.

*Irrigation* is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

*Terraces and diversions* are embankments or a combination of channels and ridges constructed across a slope to control erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

*Grassed waterways* are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts and sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

# Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

## Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

**Depth** to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under the heading "Soil Series and Their Morphology."

**Texture** is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 11). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt,

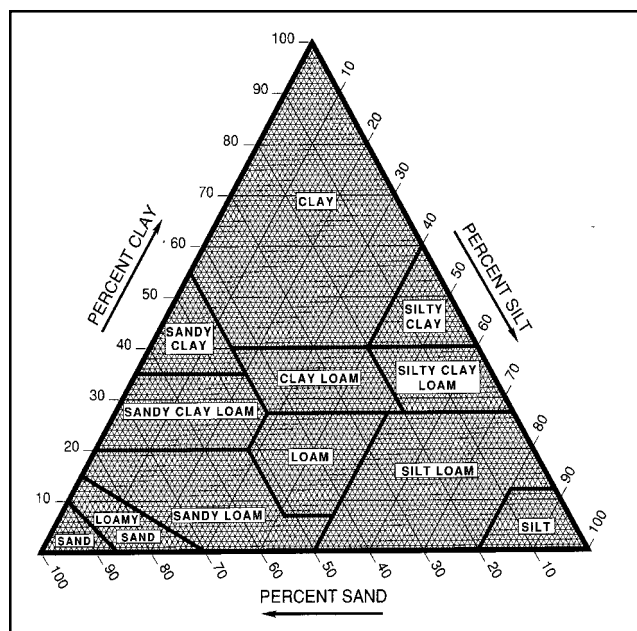


Figure 11.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

**Classification** of the soils is determined according to the Unified soil classification system (2) and the system adopted by the American Association of State Highway and Transportation Officials (1).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and

maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

*Rock fragments* 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

*Percentage (of soil particles) passing designated sieves* is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

*Liquid limit and plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

## Physical and Chemical Properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

*Clay* as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by

weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

*Moist bulk density* is the weight of soil (oven-dry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at  $\frac{1}{3}$ -bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

*Permeability* refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, and septic tank absorption fields.

*Available water capacity* refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

*Soil reaction* is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops

and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

*Salinity* is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

*Shrink-swell potential* is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

*Erosion factor K* indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

*Erosion factor T* is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

*Wind erodibility groups* are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. The soils assigned to group 1 are the most susceptible to soil blowing, and those assigned to group 8 are the least susceptible. The groups are as follows:

1. Coarse sands, sands, fine sands, and very fine sands.
2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, ash material, and sapric soil material.
3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams.
- 4L. Calcareous loams, silt loams, clay loams, and silty clay loams.
4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay.
5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material.
6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay.
7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material.
8. Soils that are not subject to soil blowing because of coarse fragments on the surface or because of surface wetness.

*Organic matter* is the plant and animal residue in the soil at various stages of decomposition. In table 16, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

## Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

*Hydrologic soil groups* are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low

runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

*Flooding*, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, and water standing in swamps and marshes is considered ponding rather than flooding.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs, on the average, once or less in 2 years (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs, on the average, more than once in 2 years (the chance of flooding is more than 50 percent in any year). Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month, and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the

extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

*High water table* (seasonal) is the highest level of a saturated zone in the soil in most years. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17. Only saturated zones within a depth of about 6 feet are indicated.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

*Depth to bedrock* is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

*Potential frost action* is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

*Risk of corrosion* pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors

as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations

that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.



# Classification of the Soils

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The system of soil classification used by the National Cooperative Soil Survey has six categories (7). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 18 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

**ORDER.** Eleven soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

**SUBORDER.** Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustoll (*Ust*, meaning humid plus T3oll, from Mollisol).

**GREAT GROUP.** Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haplustolls (*Hapl*, meaning minimal horizonation, plus *ustoll*, the suborder of the Mollisols that has an ustic moisture regime).

**SUBGROUP.** Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Udorthentic Haplustolls.

**FAMILY.** Families are established within a subgroup on the basis of physical and chemical properties and

other characteristics that affect management.

Generally the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine, mixed, mesic Udorthentic Haplustolls.

**SERIES.** The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

## Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the "Soil Survey Manual" (8). Many of the technical terms used in the descriptions are defined in "Soil Taxonomy" (7). Unless otherwise stated, matrix colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

## Benfield Series

The Benfield series consists of moderately deep, well drained, slowly permeable soils on uplands. These soils formed in colluvium over residuum weathered from clayey, calcareous shale. Slopes range from 5 to 30 percent.

Typical pedon of Benfield silty clay loam, in an area of Benfield-Florence complex, 5 to 30 percent slopes,

1,300 feet east and 2,300 feet south of the northwest corner of sec. 30, T. 11 S., R. 8 E.

A1—0 to 5 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; strong medium granular structure; slightly hard, friable, plastic and sticky; many fine roots throughout; neutral; clear smooth boundary.

A2—5 to 10 inches; very dark grayish brown (10YR 3/2) silty clay loam, very dark brown (10YR 2/2) moist; strong medium granular structure; slightly hard, friable, plastic and sticky; many fine roots throughout; 12 percent limestone and chert pebbles; mildly alkaline; clear smooth boundary.

Bt1—10 to 19 inches; dark reddish gray (5YR 4/2) gravelly silty clay, dark reddish brown (5YR 3/2) moist; moderate fine and medium angular blocky structure; hard, firm, very plastic and very sticky; common fine roots throughout; common distinct dark reddish brown (5YR 2/2) continuous clay films (cutans) on faces of peds and on rock fragments; 20 percent limestone and chert pebbles; mildly alkaline; gradual smooth boundary.

Bt2—19 to 30 inches; reddish brown (5YR 4/3) silty clay, reddish brown (5YR 5/3) crushed, dark reddish brown (5YR 3/3) and reddish brown (5YR 4/3) crushed and moist; moderate medium and coarse subangular blocky structure; very hard, very firm, very plastic and very sticky; few very fine roots between peds; few distinct dark reddish brown (5YR 3/2) discontinuous clay films (cutans) on faces of peds; 12 percent limestone and chert pebbles; mildly alkaline; clear smooth boundary.

Bt3—30 to 34 inches; reddish brown (5YR 4/3) silty clay, reddish brown (5YR 5/3) crushed, dark reddish brown (5YR 3/3) and reddish brown (5YR 4/3) crushed and moist; moderate medium and coarse subangular blocky structure; extremely hard, extremely firm, very plastic and very sticky; few very fine roots between peds; few distinct dark reddish brown (5YR 3/2) patchy clay films (cutans) on faces of peds; strongly effervescent (HCl, unspecified); 10 percent limestone and chert pebbles; moderately alkaline; clear smooth boundary.

2Btk—34 to 38 inches; olive gray (5Y 5/2) silty clay, olive gray (5Y 4/2) moist; weak medium and coarse subangular blocky structure; extremely hard, extremely firm, very plastic and very sticky; few very fine roots between peds; few prominent dark reddish brown (5YR 3/3) discontinuous clay films (cutans) on faces of peds; common fine rounded lime concretions; violently effervescent; moderately alkaline; clear smooth boundary.

2Cr—38 to 56 inches; olive gray, calcareous shale bedrock.

The depth to bedrock ranges from 20 to 40 inches. The mollic epipedon ranges from 7 to 20 inches in thickness. The depth to free carbonates ranges from 20 to 36 inches. The carbonates are in the form of concretions within a depth of 34 inches.

The A horizon has hue of 10YR or 7.5YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It is typically silty clay loam, but the range includes silt loam and gravelly silty clay loam. This horizon is slightly acid to mildly alkaline.

The Bt horizon has hue of 5YR, 7.5YR, 10YR, or 2.5Y in the upper part and hue of 5Y in the lower part. It has value of 4 to 6 (3 to 5 moist) and chroma of 2 to 6. It is silty clay, silty clay loam, or gravelly silty clay loam. It ranges from neutral to moderately alkaline.

## Clime Series

The Clime series consists of moderately deep, well drained, slowly permeable soils on uplands. These soils formed in residuum derived from calcareous, clayey shale. Slopes range from 5 to 40 percent.

Typical pedon of Clime silty clay loam, in an area of Clime-Sogn silty clay loams, 5 to 20 percent slopes, 1,420 feet west and 100 feet north of the southeast corner of sec. 29, T. 13 S., R. 7 E.

A—0 to 12 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; moderate medium granular structure; slightly hard, friable, plastic and sticky; many fine and medium roots; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bw—12 to 26 inches; light gray (2.5Y 7/2) silty clay, light brownish gray (2.5Y 6/2) moist; moderate fine subangular blocky structure; hard, firm, very plastic and very sticky; common fine and medium roots; 5 percent unconsolidated shale fragments less than 1/2 inch in diameter; strongly effervescent; moderately alkaline; clear smooth boundary.

C—26 to 30 inches; light gray (5Y 7/2) silty clay, pale olive gray (5Y 6/3) moist; massive; hard, firm, very plastic and very sticky; few fine roots; 20 percent unconsolidated shale fragments less than 1 inch in diameter; strongly effervescent; moderately alkaline; clear smooth boundary.

Cr—30 inches; calcareous, clayey shale bedrock.

The mollic epipedon is 7 to 20 inches thick. The depth to shale bedrock ranges from 20 to 40 inches. The depth to free carbonates ranges from 0 to 10

inches. The soils typically are mildly alkaline or moderately alkaline throughout, but some pedons are neutral in the upper 10 inches.

The A horizon has hue of 10YR or 2.5Y, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It is typically silty clay loam, but in some pedons it is silty clay. The content of limestone fragments, 3 inches to 2 feet in diameter, ranges from 0 to 10 percent.

The Bw horizon has hue of 10YR or 2.5Y, value of 4 to 7 (3 to 6 moist), and chroma of 1 to 4. It is silty clay, clay, or silty clay loam. The content of shale fragments, less than 3 inches in diameter, ranges from 0 to 10 percent.

The C horizon has hue of 10YR to 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is clay, silty clay, or silty clay loam. The content of shale fragments is less than 35 percent.

## Crete Series

The Crete series consists of very deep, moderately well drained, slowly permeable soils on uplands. These soils formed in loess. Slopes range from 1 to 8 percent.

Typical pedon of Crete silty clay loam, 1 to 4 percent slopes, 1,800 feet west and 500 feet north of the southeast corner of sec. 28, T. 10 S., R. 5 E.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak thin platy structure parting to moderate medium granular; slightly hard, very friable, slightly plastic and slightly sticky; many medium roots throughout; medium acid; abrupt smooth boundary.

BA—6 to 11 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, friable, plastic and sticky; many fine and medium roots throughout; neutral; abrupt smooth boundary.

Bt1—11 to 20 inches; brown (10YR 4/3) silty clay, dark brown (10YR 3/3) moist; moderate medium and coarse subangular blocky structure; extremely hard, very firm, very plastic and very sticky; common fine roots throughout; vertical cracks filled with very dark brown (10YR 2/2) material; common faint very dark grayish brown (10YR 3/2) discontinuous clay films (cutans) on faces of peds; neutral; gradual smooth boundary.

Bt2—20 to 27 inches; brown (10YR 5/3) silty clay, dark brown (10YR 3/3) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; very hard, very firm, very plastic and very sticky; common fine roots

throughout; common faint very dark grayish brown (10YR 3/2) discontinuous clay films (cutans) on faces of peds and common intersecting slickensides; mildly alkaline; clear wavy boundary.

Btk—27 to 40 inches; brown (10YR 5/3) silty clay, dark grayish brown (2.5Y 4/2) moist; common fine distinct dark yellowish brown (10YR 4/4) and few medium faint grayish brown (2.5Y 5/2) mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, very firm, very plastic and very sticky; common fine roots throughout; common faint dark brown (10YR 3/3) discontinuous clay films (cutans) and few intersecting slickensides; common fine rounded carbonate concretions; mildly alkaline; clear wavy boundary.

Bt—40 to 51 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 4/3) moist; common fine distinct brown (7.5YR 4/4) and common medium distinct grayish brown (2.5Y 5/2) mottles; moderate medium prismatic structure parting to moderate medium angular blocky; very hard, firm, very plastic and very sticky; few fine roots throughout; common distinct dark brown (10YR 3/3) discontinuous clay films (cutans) on vertical faces of peds; mildly alkaline; clear smooth boundary.

BC—51 to 60 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 4/3) moist; many medium distinct strong brown (7.5YR 5/6) mottles along root channels; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, very plastic and very sticky; few very fine roots throughout; few krotovinas 3 inches in diameter; few faint dark grayish brown (10YR 4/2) discontinuous clay films (cutans) on vertical faces of peds and manganese or iron-manganese stains; moderately alkaline; clear smooth boundary.

2Btb1—63 to 70 inches; pale brown (10YR 6/3) silty clay loam, dark grayish brown (10YR 4/2) moist; common medium distinct strong brown (7.5YR 5/6) and common grayish brown (2.5Y 5/2) mottles along root channels; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, plastic and sticky; few very fine roots between peds; many very fine and fine tubular pores; common faint very dark grayish brown (10YR 3/2) discontinuous clay films (cutans) on vertical faces of peds and few faint skeletans (sand or silt) on faces of peds; few fine rounded iron-manganese concretions; moderately alkaline.

The mollic epipedon ranges from 20 to 36 inches in thickness. The depth to carbonates commonly ranges from 25 to 40 inches. The carbonates are generally in the form of concretions.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It is typically silty clay loam, but the range includes silt loam. This horizon is medium acid to neutral.

The Bt horizon has hue of 10YR or 2.5Y, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. It is typically silty clay with 42 to 52 percent clay. It is slightly acid to moderately alkaline.

The BC horizon has hue of 10YR to 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It has mottles in some pedons. It is silty clay or silty clay loam. Some pedons have a C horizon.

## Eudora Series

The Eudora series consists of very deep, well drained, moderately permeable soils on flood plains along the major rivers. These soils formed in silty alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Eudora silt loam, occasionally flooded, 3,100 feet north and 1,300 feet east of the north end of the bridge across the Republican River at the north end of Junction City; 39 degrees, 3 minutes, 8 seconds north latitude and 96 degrees, 49 minutes, 34 seconds west longitude.

Ap—0 to 7 inches; silt loam that is dark grayish brown (10YR 4/2) crushed, very dark grayish brown (10YR 3/2) crushed and moist; weak fine subangular blocky structure parting to moderate medium granular; slightly hard, friable, slightly plastic and slightly sticky; common medium roots throughout; few fine tubular pores; moderately alkaline; clear smooth boundary.

A1—7 to 14 inches; silt loam that is very dark grayish brown (10YR 3/2) crushed, very dark brown (10YR 2/2) crushed and moist; moderate medium granular structure; slightly hard, friable, slightly plastic and slightly sticky; common medium roots throughout; few fine tubular pores; moderately alkaline; clear wavy boundary.

A2—14 to 19 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) crushed and moist; moderate medium subangular blocky structure parting to moderate medium granular; slightly hard, friable, slightly plastic and slightly sticky; common fine and few medium roots throughout; few krotovinas,  $\frac{3}{4}$  inch to 2 inches in diameter, filled with grayish brown (10YR 5/2) material; mildly alkaline; gradual smooth boundary.

C1—19 to 26 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; massive; soft, very friable, nonplastic and nonsticky; common fine and few very coarse roots throughout; few distinct dark

grayish brown (10YR 4/2) organic coatings on vertical faces of peds; mildly alkaline; gradual wavy boundary.

C2—26 to 32 inches; silt loam that is very pale brown (10YR 7/3) crushed, pale brown (10YR 6/3) crushed and moist; massive; soft, very friable, nonplastic and nonsticky; common fine and medium roots throughout; few krotovinas,  $\frac{3}{4}$  inch to 2 inches in diameter, filled with dark grayish brown (10YR 4/2) material; moderately alkaline; gradual irregular boundary.

C3—32 to 40 inches; stratified 75 percent very pale brown (10YR 7/3) and 25 percent light brownish gray (10YR 6/2) silt loam, 75 percent pale brown (10YR 6/3) and 25 percent dark grayish brown (10YR 4/2) moist; weak thin platy structure; soft, very friable, nonplastic and nonsticky; few fine roots throughout; soil colors are finely stratified  $\frac{1}{16}$  to  $\frac{1}{8}$  inch thick (bedding planes); moderately alkaline; clear smooth boundary.

C4—40 to 49 inches; very pale brown (10YR 7/3) very fine sandy loam, pale brown (10YR 6/3) moist; massive; soft, very friable, nonplastic and nonsticky; few very fine roots throughout; moderately alkaline; abrupt smooth boundary.

C5—49 to 52 inches; stratified 95 percent very pale brown (10YR 7/3) and 5 percent gray (10YR 5/1) very fine sandy loam, 95 percent pale brown (10YR 6/3) and 5 percent very dark gray (10YR 3/1) moist; weak thin platy structure; soft, very friable, nonplastic and nonsticky; few very fine roots throughout; soil colors are finely stratified  $\frac{1}{16}$  to  $\frac{1}{8}$  inch thick (bedding planes); few krotovinas, 1 inch in diameter, filled with brown (10YR 5/3) material; moderately alkaline; abrupt smooth boundary.

C6—52 to 60 inches; very pale brown (10YR 7/3) very fine sandy loam, very pale brown (10YR 7/3) moist; massive; soft, very friable, nonplastic and nonsticky; few medium roots throughout; few discontinuous strata  $\frac{1}{16}$  to  $\frac{1}{8}$  inch thick; moderately alkaline.

The thickness of the mollic epipedon ranges from 10 to 24 inches. The depth to free carbonates ranges from 20 to more than 60 inches.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It is typically silt loam, but the range includes very fine sandy loam. This horizon ranges from slightly acid to mildly alkaline.

The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 1 to 3. It is typically silt loam or very fine sandy loam.

Some pedons have buried soils below a depth of 60 inches.

## Florence Series

The Florence series consists of deep, well drained, moderately slowly permeable soils in the uplands. These soils formed in residuum derived from cherty limestone. Slopes range from 5 to 15 percent.

Typical pedon of Florence gravelly silt loam, in an area of Benfield-Florence complex, 5 to 30 percent slopes, 600 feet north and 200 feet west of the southeast corner of sec. 29, T. 11 S., R. 8 E.

- A1—0 to 5 inches; dark grayish brown (10YR 4/2) gravelly silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable, slightly plastic and slightly sticky; many fine and medium roots; 20 percent chert fragments  $\frac{1}{2}$  inch to 2 inches in diameter; neutral; clear smooth boundary.
- A2—5 to 14 inches; brown (7.5YR 4/2) very cobbly silty clay, dark brown (7.5YR 3/2) moist; weak medium subangular blocky structure; hard, firm, very plastic and very sticky; many fine roots; 50 percent chert fragments  $\frac{1}{2}$  inch to 4 inches in diameter; slightly acid; clear smooth boundary.
- Bt1—14 to 37 inches; reddish brown (5YR 4/4) very cobbly clay, dark reddish brown (5YR 3/4) moist; few fine distinct red (2.5YR 4/6) mottles; moderate medium subangular blocky structure; very hard, very firm, very plastic and very sticky; thin continuous clay film on faces of peds; 50 percent chert fragments 1 to 4 inches in diameter; common fine roots; slightly acid; gradual smooth boundary.
- Bt2—37 to 48 inches; dark reddish brown (2.5YR 3/4) very cobbly clay, dark red (2.5YR 3/6) moist, common fine distinct brown (10YR 5/3) and red (2.5YR 4/6) mottles; moderate medium subangular blocky structure; very hard, very firm, very plastic and very sticky; few thin continuous clay films on faces of peds; 50 percent chert fragments 1 to 4 inches in diameter; few fine roots; slightly acid; diffuse wavy boundary.
- Btk—48 to 56 inches; reddish brown (5YR 5/4) very cobbly silty clay, reddish brown (5YR 4/4) moist; light brown and reddish yellow (7.5YR 6/4 and 7.5YR 6/6) weathered calcareous limestone; massive; very hard, very firm; few fine roots; 50 percent limestone and chert fragments 1 to 3 inches in diameter; violently effervescent; mildly alkaline.
- R—56 inches; cherty limestone bedrock.

The depth to bedrock ranges from 40 to 60 inches. The mollic epipedon ranges from 10 to 20 inches in thickness.

The A horizon has hue of 10YR or 7.5YR, value of 3

or 4 (2 or 3 moist), and chroma of 1 or 2. It is typically gravelly silt loam, but the range includes silt loam, silty clay loam, and gravelly silty clay loam. This horizon ranges from medium acid to neutral.

The Bt horizon has hue of 7.5YR to 2.5YR, value of 3 to 5, moist or dry, and chroma of 3 to 6. It is cobbly clay, very cobbly clay, cobbly silty clay, or very cobbly silty clay. It ranges from medium acid to mildly alkaline.

## Geary Series

The Geary series consists of very deep, well drained, moderately permeable soils on uplands. These soils formed in reddish brown silty sediments that are reworked loess. Slopes range from 3 to 15 percent.

Typical pedon of Geary silt loam, 3 to 8 percent slopes, 1,000 feet north, 1,100 feet east of the southwest corner of sec. 15, T. 11 S., R. 5 E.

- A1—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable, slightly plastic and slightly sticky; many fine and medium roots; medium acid; clear smooth boundary.
- A2—8 to 18 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; slightly hard, friable, slightly plastic and slightly sticky; common fine and medium roots; medium acid; clear smooth boundary.
- Bt1—18 to 25 inches; brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, plastic and sticky; few fine roots; few discontinuous clay films on faces of peds; medium acid; clear smooth boundary.
- Bt2—25 to 48 inches; brown (7.5YR 5/4) silty clay loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; hard, firm, plastic and sticky; few fine roots; few continuous clay films on faces of peds; medium acid; gradual smooth boundary.
- Bt3—48 to 60 inches; strong brown (7.5YR 5/6) silty clay loam, strong brown (7.5YR 4/6) moist; weak fine angular blocky structure; hard, firm, plastic and sticky; few fine roots; few clay films on faces of peds; medium acid.

The mollic epipedon ranges from 10 to 20 inches in thickness. The A horizon has hue of 7.5YR or 10YR, value of 3 to 5 (2 or 3 moist), and chroma of 2 or 3. It is typically silt loam, but the range includes silty clay loam. This horizon is medium acid or slightly acid.

The Bt horizon has value of 4 to 6 (3 to 5 moist) and chroma of 3 to 6. It is silty clay loam or clay loam averaging 27 to 35 percent clay. It ranges from medium acid to mildly alkaline.

## Haynie Series

The Haynie series consists of very deep, well drained, moderately permeable soils on flood plains. These soils formed in calcareous silty alluvium. Slopes are 0 to 1 percent.

Typical pedon of Haynie silt loam, frequently flooded, 1,800 feet east and 1,700 feet south of the northwest corner of sec. 33, T. 12 S., R. 5 E.

A—0 to 10 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable, slightly plastic and slightly sticky; common fine roots throughout; few strata of brown (10YR 5/3) silt loam less than  $\frac{1}{8}$  inch thick; slightly effervescent; neutral; clear wavy boundary.

C—10 to 60 inches; light brownish gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable, slightly plastic and slightly sticky; few strata of dark gray (10YR 4/1) silty clay loam about  $\frac{3}{4}$  inch thick; strongly effervescent; mildly alkaline.

The depth to free carbonates ranges from 0 to 10 inches. The soils are mildly alkaline or moderately alkaline throughout.

The A horizon is dominantly silt loam, but the range includes very fine sandy loam and silty clay loam.

The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 or 5 moist), and chroma of 2 to 4. It is silt loam or very fine sandy loam. Some pedons have mottles in the C horizon.

## Hobbs Series

The Hobbs series consists of very deep, well drained, moderately permeable soils on flood plains. These soils formed in silty alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Hobbs silt loam, occasionally flooded, 700 feet east and 100 feet north of the southwest corner of sec. 26, T. 10 S., R. 4 E.

A—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) exterior, very dark grayish brown (10YR 3/2) crushed and moist; moderate medium granular structure; slightly hard, very friable, slightly sticky, slightly plastic; many fine roots throughout; neutral; clear smooth boundary.

C1—8 to 24 inches; stratified 50 percent grayish brown (10YR 5/2), 30 percent dark grayish brown (10YR 4/2), and 20 percent light brownish gray (10YR 6/2) silt loam, 50 percent dark grayish brown (10YR 4/2), 30 percent very dark grayish brown (10YR 3/2), and 20 percent pale brown (10YR 6/3) moist; weak coarse subangular blocky structure; slightly hard, very friable, slightly sticky, slightly plastic; many fine roots throughout; slightly acid; clear smooth boundary.

C2—24 to 44 inches; brown (10YR 4/3) silt loam, dark brown (10YR 3/3) moist; massive; slightly hard, very friable, slightly sticky, slightly plastic; common fine roots throughout; slightly acid; gradual smooth boundary.

C3—44 to 60 inches; stratified 50 percent brown (10YR 4/3), 30 percent dark grayish brown (10YR 4/2), and 20 percent light brownish gray (10YR 6/2) silt loam, 50 percent dark brown (10YR 3/3), 30 percent very dark grayish brown (10YR 3/2), and 20 percent grayish brown (10YR 5/2) moist; common fine distinct dark yellowish brown (10YR 4/6) mottles; massive; slightly hard, very friable, slightly sticky, slightly plastic; few fine roots throughout; slightly acid.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is typically silt loam, but in some pedons it is silty clay loam. It ranges from slightly acid to mildly alkaline.

The C horizon has value of 4 to 7 (3 to 5 moist) and chroma of 1 to 3. It is silt loam or silty clay loam. It ranges from slightly acid to mildly alkaline.

## Holder Series

The Holder series consists of very deep, well drained, moderately permeable soils on uplands. These soils formed in loess. Slopes range from 1 to 7 percent.

Typical pedon of Holder silt loam, 3 to 7 percent slopes, 300 feet north and 1,300 feet west of the southeast corner of sec. 14, T. 10 S., R. 4 E.

A—0 to 8 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; soft, friable, slightly plastic and slightly sticky; many fine roots throughout; strongly acid; clear smooth boundary.

BA—8 to 14 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; soft, friable; many very fine and fine roots throughout; medium acid; gradual smooth boundary.

Bt1—14 to 21 inches; brown (10YR 5/3) silty clay

loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; slightly hard, friable, plastic and sticky; common very fine and fine roots throughout; few faint dark brown (10YR 3/3) clay films (cutans) on faces of peds; slightly acid; gradual smooth boundary.

Bt2—21 to 45 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; moderate medium subangular blocky structure; slightly hard, firm; few very fine roots throughout; very few faint dark brown (10YR 3/3) clay films (cutans) on faces of peds; slightly acid; gradual smooth boundary.

BC—45 to 58 inches; pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; weak coarse subangular blocky structure; soft, friable; neutral; gradual smooth boundary.

Ck—58 to 60 inches; brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; massive; slightly hard, firm; common fine and medium rounded lime concretions; mildly alkaline.

The thickness of the mollic epipedon ranges from 10 to 20 inches. The depth to carbonates ranges from 36 to 60 inches.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2. It ranges from strongly acid to neutral.

The Bt horizon has value of 4 to 6 (4 or 5 moist) and chroma of 2 or 3. It ranges from slightly acid to mildly alkaline.

The BC horizon has value of 5 to 7 (5 or 6 moist) and chroma of 2 or 3. It is neutral or mildly alkaline.

The C horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2 or 3. Reaction is neutral to moderately alkaline.

## Irwin Series

The Irwin series consists of deep and very deep, moderately well drained, very slowly permeable soils on uplands. These soils formed in clayey sediments over residuum weathered from limestone. Slopes range from 3 to 7 percent.

Typical pedon of Irwin silty clay loam, 3 to 7 percent slopes, 2,340 feet east and 320 feet north of the southwest corner of sec. 25, T. 13 S., R. 8 E.

A1—0 to 6 inches; very dark gray (10YR 3/1) silty clay loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; hard, friable, slightly plastic and slightly sticky; many fine and medium roots throughout; few distinct gray (10YR 5/1) discontinuous skeletans (sand or silt) on faces of peds; strongly acid; clear smooth boundary.

BA—6 to 13 inches; very dark grayish brown (10YR

3/2) silty clay loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; hard, firm, plastic and sticky; many fine roots throughout; few distinct gray (10YR 5/1) discontinuous skeletans (sand or silt) on faces of peds; strongly acid; abrupt smooth boundary.

Bt1—13 to 23 inches; dark grayish brown (10YR 4/2) clay, very dark grayish brown (10YR 2/2) and very dark grayish brown (10YR 3/2) crushed and moist; strong medium subangular blocky structure; very hard, very firm, very plastic and very sticky; common very fine and fine roots throughout; few faint very dark brown (10YR 2/2) continuous clay films (cutans) on faces of peds; slightly acid; gradual smooth boundary.

Bt2—23 to 30 inches; brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; moderate medium blocky structure; extremely hard, extremely firm, very plastic and very sticky; common very fine roots between peds; few faint very dark grayish brown (10YR 3/2) discontinuous clay films (cutans) on faces of peds; neutral; gradual smooth boundary.

Btk—30 to 41 inches; brown (10YR 5/3) silty clay, brown (10YR 4/3) moist; weak medium blocky structure; very hard, very firm, very plastic and very sticky; few very fine roots throughout; very few faint discontinuous clay films (cutans) on faces of peds; common fine and medium rounded lime concretions; mildly alkaline; gradual smooth boundary.

2Bt1—41 to 54 inches; brown (7.5YR 5/4) silty clay loam, brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; hard, firm, plastic and sticky; very few discontinuous clay films (cutans) on faces of peds; moderately alkaline; clear smooth boundary.

2Bt2—54 to 72 inches; 70 percent dark brown (7.5YR 4/4) and 30 percent brown (10YR 5/3) silty clay loam, 70 percent dark brown (7.5YR 3/4), 20 percent brown (10YR 4/3), and 10 percent dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure; hard, firm, plastic and sticky; very few faint discontinuous clay films (cutans) on faces of peds; 1 percent limestone pebbles; mildly alkaline.

The mollic epipedon is more than 20 inches thick. A subhorizon containing more than 40 percent clay is located within a depth of 14 inches. Lime concretions occur below 24 inches in some pedons.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 to 3. It is typically silty clay loam, but the range includes silt loam and silty clay. This horizon ranges from medium acid to neutral.

The Bt and 2Bt horizons have hue of 10YR or

7.5YR, value of 4 to 6 (3 or 4 moist), and chroma of 2 to 4. They are silty clay or clay. They range from slightly acid to moderately alkaline.

### Kahola Series

The Kahola series consists of very deep, well drained, moderately permeable soils on flood plains. These soils formed in calcareous silty alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Kahola silt loam, occasionally flooded, 400 feet south and 2,200 feet east of the northwest corner of sec. 6, T. 10 S., R. 5 E.

Ap—0 to 6 inches; very dark grayish brown (10YR 3/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, very friable, slightly sticky, slightly plastic; common fine roots throughout; neutral; clear smooth boundary.

A1—6 to 18 inches; very dark grayish brown (10YR 3/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine and medium granular structure; slightly hard, very friable, slightly sticky, slightly plastic; common fine roots throughout; neutral; gradual smooth boundary.

A2—18 to 24 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky, slightly plastic; common fine roots throughout; mildly alkaline; clear smooth boundary.

A3—24 to 36 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; slightly hard, very friable, slightly sticky, slightly plastic; common fine roots throughout; slightly effervescent; moderately alkaline; gradual smooth boundary.

AC—36 to 44 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky, slightly plastic; few fine roots throughout; strongly effervescent; moderately alkaline; gradual smooth boundary.

C1—44 to 60 inches; brown (10YR 4/3) silt loam, dark brown (10YR 3/3) moist; few fine distinct dark yellowish brown (10YR 4/6) mottles; massive; slightly hard, very friable, slightly sticky, slightly plastic; strongly effervescent; moderately alkaline.

The mollic epipedon is more than 24 inches thick. The depth to free carbonates ranges from 15 to 40 inches.

The A and AC horizons have value of 3 to 5 (2 or 3

moist) and chroma of 1 to 3. They are typically silt loam, but in some pedons they are silty clay loam. They range from slightly acid to moderately alkaline.

The C horizon has value of 4 or 5 (2 to 4 moist) and chroma of 2 to 4. It is silt loam, loam, or silty clay loam.

### Konza Series

The Konza series consists of very deep, moderately well drained, very slowly permeable soils on uplands. These soils formed in loess over a paleosol formed in residuum weathered from limestone on uplands. Slopes range from 1 to 3 percent.

Typical pedon of Konza silty clay loam, 1 to 3 percent slopes, 800 feet south and 200 feet east of the northwest corner of sec. 25, T. 12 S., R. 7 E.

A—0 to 6 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; moderate medium granular structure; soft, very friable, sticky and plastic; many fine roots throughout; very few distinct dark gray (10YR 4/1) discontinuous skeletans (sand or silt) on faces of peds; slightly acid (pH 6.1); clear smooth boundary.

Bt1—6 to 17 inches; dark grayish brown (10YR 4/2) silty clay, very dark brown (10YR 2/2) moist; weak medium columnar structure parting to strong fine and medium angular blocky; very hard, very firm, very sticky and very plastic; common fine roots between peds; common distinct very dark brown (10YR 2/2) continuous clay films (cutans) on vertical and horizontal faces of peds, and few black (10YR 2/1) patchy organic coatings on vertical faces of peds; medium acid (pH 5.7); gradual smooth boundary.

Bt2—17 to 28 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse subangular blocky structure; very hard, very firm, very sticky and very plastic; common fine roots between peds; many distinct very dark brown (10YR 2/2) continuous clay films (cutans) on vertical and horizontal faces of peds, and few black (10YR 2/1) patchy organic coatings on vertical faces of peds; neutral (pH 7.0); clear smooth boundary.

Btk1—28 to 34 inches; brown (10YR 5/3) silty clay, dark brown (10YR 4/3) moist; moderate fine and medium subangular blocky structure; very hard, firm, very sticky, and very plastic; few very fine roots between peds; common distinct very dark grayish brown (10YR 3/2) continuous clay films (cutans) on vertical and horizontal faces of peds, and very few very dark brown (10YR 2/2) patchy organic coatings on vertical faces of peds; few fine

rounded carbonate concretions; sodium absorption ratio of 7; mildly alkaline (pH 7.8); clear smooth boundary.

Btk2—34 to 42 inches; 75 percent brown (10YR 5/3) and 25 percent grayish brown (10YR 5/2) silty clay loam, 75 percent dark brown (10YR 4/3) and 25 percent dark grayish brown (10YR 4/2) moist; common fine distinct dark yellowish brown (10YR 4/6) mottles; moderate medium subangular blocky structure; hard, firm, very sticky and very plastic; few very fine roots throughout; few distinct dark brown (10YR 3/3) patchy clay films (cutans) on vertical faces of peds; common fine and medium rounded carbonate concretions; sodium adsorption ratio of 8; moderately alkaline (pH 7.9); clear smooth boundary.

Bt—42 to 50 inches; 80 percent grayish brown (10YR 5/2) and 20 percent light brownish gray (10YR 6/2) silty clay loam, 80 percent dark grayish brown (10YR 4/2) and 20 percent grayish brown (10YR 5/2) moist; common fine and medium prominent dark yellowish brown (10YR 4/6) mottles; weak fine and medium subangular blocky structure; hard, friable, sticky and plastic; few very fine roots throughout; very few prominent dark grayish brown (10YR 4/2) patchy clay films (cutans) on vertical faces of peds; sodium adsorption ratio of 8; moderately alkaline (pH 7.9); clear smooth boundary.

2Btb1—50 to 62 inches; 50 percent brown (7.5YR 4/4) and 50 percent grayish brown (10YR 5/2) silty clay loam, 50 percent dark brown (7.5YR 3/4) and 50 percent dark grayish brown (10YR 4/2) moist; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; few distinct dark brown (7.5YR 3/4) patchy clay films (cutans) on vertical faces of peds, and very few manganese or iron-manganese stains on faces of peds; sodium adsorption ratio of 8; neutral (pH 7.2); gradual smooth boundary.

2Btb2—62 to 70 inches; 75 percent dark brown (7.5YR 4/4) and 25 percent reddish brown (5YR 4/3) silty clay, 75 percent dark brown (7.5YR 3/4) and 25 percent dark reddish brown (5YR 3/3) moist; moderate fine and medium subangular blocky structure; very hard, very firm, very sticky and very plastic; common distinct dark reddish brown (5YR 3/3) continuous clay films (cutans) on vertical and horizontal faces of peds, and patchy manganese or iron-manganese stains on faces of peds; sodium adsorption ratio of 8; 1 percent gravel, mostly chert and limestone pebbles; mildly alkaline (pH 7.5); clear smooth boundary.

2Btb3—70 to 80 inches; reddish brown (5YR 4/3) silty

clay, dark reddish brown (5YR 3/3) moist; strong fine and medium angular blocky structure; very hard, very firm, very sticky and very plastic; common distinct dark reddish brown (5YR 3/3) continuous clay films (cutans) on vertical and horizontal faces of peds, and common patchy manganese or iron-manganese stains on faces of peds; sodium adsorption ratio 7; 1 percent gravel, mostly chert and limestone pebbles; mildly alkaline (pH 7.6).

The depth to limestone or shale bedrock is more than 60 inches. The mollic epipedon ranges from 20 to 36 inches in thickness. The depth to discontinuity ranges from 35 to 65 inches. Cracks form during dry periods. They are 1 centimeter or more in width and extend to a depth of 20 inches or more.

The clay content is greater than 42 percent within a depth of 8 inches.

The A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 1 or 2. It is medium acid to neutral.

The Bt horizon has value of 4 to 6 (3 or 4 moist) and chroma of 2 to 4. It is silty clay or clay averaging about 42 to 60 percent clay. Reaction ranges from medium acid to neutral in the upper part of this horizon and from slightly acid to moderately alkaline in the lower part. The sodium adsorption ratio ranges from 2 to 12.

The 2Btb horizon has hue of 10YR to 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. It is silty clay loam or silty clay. It ranges from neutral to moderately alkaline. The sodium adsorption ratio ranges from 4 to 8.

## Ladysmith Series

The Ladysmith series consists of very deep, somewhat poorly drained, very slowly permeable soils on uplands. These soils formed in clayey sediments. Slopes range from 0 to 2 percent.

Typical pedon of Ladysmith silty clay loam, 0 to 2 percent slopes, 2,320 feet south and 400 feet east of the northwest corner of sec. 27, T. 13 S., R. 8 E.

A—0 to 7 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; moderate fine granular structure; hard, firm, plastic and sticky; many fine roots; medium acid; clear smooth boundary.

Bt1—7 to 15 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; moderate fine blocky structure; very hard, very firm, very plastic and very sticky; few fine roots; common clay films on faces of peds; slightly acid; gradual smooth boundary.

Bt2—15 to 30 inches; dark gray (10YR 4/1) clay, very

dark gray (10YR 3/1) moist; few fine faint dark yellowish brown (10YR 4/4) mottles; moderate medium blocky structure; very hard, very firm, very plastic and very sticky; few fine roots; common clay films on faces of peds; medium acid; gradual smooth boundary.

B<sub>Ck</sub>—30 to 38 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; few fine faint dark brown (10YR 4/3) mottles and common medium distinct yellowish brown (10YR 5/6) mottles; weak medium subangular blocky structure; very hard, very firm, very plastic and very sticky; few fine lime concretions; moderately alkaline; gradual smooth boundary.

C<sub>1</sub>—38 to 48 inches; pale brown (10YR 6/3) silty clay, brown (10YR 5/3) moist; few fine faint brown (10YR 4/3) and common medium distinct yellowish brown (10YR 5/6) mottles; massive; very hard, firm, very plastic and very sticky; few fine lime concretions; moderately alkaline; gradual smooth boundary.

C<sub>2</sub>—48 to 60 inches; very pale brown (10YR 7/3) silty clay, pale brown (10YR 6/3) moist; common medium distinct yellowish brown (10YR 5/6) and common medium prominent reddish yellow (5YR 7/6) mottles; massive; very hard, firm, very plastic and very sticky; moderately alkaline.

The thickness of the mollic epipedon ranges from 20 to 40 inches. The depth to carbonates typically ranges from 30 to 60 inches.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 2 or less. It is typically silty clay loam, but in some pedons it is silt loam. It ranges from medium acid to neutral.

The B<sub>t</sub> horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 or 2 in the upper part and hue of 10YR or 2.5Y, value of 4 or 5 (3 or 4 moist), and chroma of 1 or 2 in the lower part. It is silty clay or clay. It ranges from medium acid to mildly alkaline. Most pedons have brownish mottles in the lower part.

The C horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 1 to 3. Most pedons have reddish or brownish mottles. It is silty clay, silty clay loam, or clay. It is mildly alkaline or moderately alkaline.

## Longford Series

The Longford series consists of very deep, well drained, slowly permeable soils on uplands. These soils formed in alluvium. Slopes range from 1 to 3 percent.

Typical pedon of Longford loam, 1 to 3 percent

slopes, 1,800 feet west and 200 feet north of the southeast corner of sec. 13, T. 12 S., R. 4 E.

A<sub>p</sub>—0 to 6 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable, slightly plastic and slightly sticky; many fine roots throughout; slightly acid; clear smooth boundary.

A—6 to 11 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable, slightly plastic and slightly sticky; many fine roots throughout; slightly acid; clear smooth boundary.

B<sub>A</sub>—11 to 16 inches; mixed dark grayish brown (10YR 4/2) and dark brown (10YR 4/3) clay loam, mixed very dark grayish brown (10YR 3/2) and brown (10YR 5/3) moist; weak fine subangular blocky structure; hard, firm, plastic and sticky; common very fine and fine roots throughout; neutral; clear smooth boundary.

B<sub>t1</sub>—16 to 27 inches; brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; very hard, very firm, plastic and sticky; few very fine roots throughout; few faint clay films (cutans) on faces of peds; few fine rounded dark concretions; neutral; gradual smooth boundary.

B<sub>t2</sub>—27 to 46 inches; brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) moist; moderate medium subangular blocky structure; very hard, very firm, plastic and sticky; few faint clay films (cutans) on faces of peds; few fine rounded dark concretions; neutral; gradual smooth boundary.

B<sub>C</sub>—46 to 54 inches; brown (7.5YR 5/4) clay loam, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; hard, firm, plastic and sticky; neutral; gradual smooth boundary.

C—54 to 60 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) moist; massive; hard, firm, slightly plastic and slightly sticky; neutral.

The thickness of the mollic epipedon ranges from 10 to 20 inches. The depth to free carbonates ranges from 36 to more than 60 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is typically loam, but the range includes clay loam and silty clay loam. This horizon is medium acid to neutral.

The B<sub>t</sub> horizon has hue of 7.5YR or 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 6. It is clay loam, silty clay loam, or silty clay. The average clay content is 35 to 45 percent. Reaction is slightly acid or neutral.

The C horizon has hue of 5YR to 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 3 to 6. It is loam or clay loam. Reaction is slightly acid to mildly alkaline.

### McCook Series

The McCook series consists of very deep, well drained, moderately permeable soils on high and low flood plains along the major rivers. These soils formed in calcareous silty alluvium. Slopes range from 0 to 2 percent.

Typical pedon of McCook silt loam, occasionally flooded, 1,900 feet east and 1,600 feet north of the southwest corner of sec. 27, T. 12 S., R. 5 E.

- Ap—0 to 8 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable, nonplastic and nonsticky; many fine and medium roots; strongly effervescent; moderately alkaline; clear smooth boundary.
- A—8 to 16 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable, nonplastic and nonsticky; many fine and medium roots; strongly effervescent; moderately alkaline; clear smooth boundary.
- AC—16 to 25 inches; light brownish gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) moist; moderate fine granular structure; slightly hard, friable, nonplastic and nonsticky; few fine roots; strongly effervescent; moderately alkaline; gradual smooth boundary.
- C1—25 to 44 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; few fine distinct yellowish brown (10YR 5/6) mottles; massive; slightly hard, friable, nonplastic and nonsticky; few fine roots; strongly effervescent; moderately alkaline; clear smooth boundary.
- C2—44 to 54 inches; light brownish gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) moist; massive; slightly hard, friable, nonplastic and nonsticky; few fine roots; strongly effervescent; moderately alkaline; clear smooth boundary.
- C3—54 to 60 inches; stratified grayish brown (10YR 5/2) with light brownish gray (10YR 6/2) silt loam, stratified dark grayish brown (10YR 4/2) with grayish brown (10YR 5/2) moist; massive; hard, firm, plastic and sticky; few fine roots; few lime threads; strongly effervescent; moderately alkaline.

The thickness of the mollic epipedon ranges from 10 to 20 inches. All horizons are mildly or moderately alkaline.

The A horizon has value of 4 or 5 (2 or 3 moist) and

chroma of 1 or 2. It is typically silt loam, but the range includes very fine sandy loam and loam.

The AC and C horizons have value of 5 to 7 (4 to 6 moist) and chroma of 2 or 3. They are typically silt loam, but include very fine sandy loam. Thin strata of contrasting color are common.

### Muir Series

The Muir series consists of very deep, well drained, moderately permeable soils on high flood plains along the major rivers and streams. These soils formed in silty alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Muir silt loam, rarely flooded, 1,400 feet north and 200 feet west of the southeast corner of sec. 24, T. 12 S., R. 4 E.

- Ap—0 to 4 inches; dark gray (10YR 4/1) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable, slightly plastic and slightly sticky; common fine roots throughout; neutral; abrupt smooth boundary.
- A—4 to 16 inches; dark gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) moist; moderate fine granular structure; slightly hard, friable, slightly plastic and slightly sticky; common fine roots throughout; neutral; clear smooth boundary.
- Bw1—16 to 24 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; strong fine subangular blocky structure; hard, friable, slightly plastic and slightly sticky; common fine roots throughout; slightly acid; gradual smooth boundary.
- Bw2—24 to 44 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate fine subangular blocky structure; hard, friable, slightly plastic and slightly sticky; few very fine and fine roots throughout; medium acid; gradual smooth boundary.
- C—44 to 60 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; common fine faint dark yellowish brown (10YR 4/4) mottles; massive; hard, friable, slightly plastic and slightly sticky; few very fine roots throughout; slightly acid.

The mollic epipedon ranges from 20 to more than 40 inches in thickness. The depth to carbonates is more than 48 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It is typically silt loam, but the range includes silty clay loam and loam. This horizon is medium acid to neutral.

The Bw horizon has value of 4 to 6 (2 to 4 moist) and chroma of 2 or 3. It is typically silt loam or silty clay loam. It is medium acid to neutral.

The C horizon has hue of 7.5YR or 10YR, value of 4 to 7 (3 to 5 moist), and chroma of 2 to 4. It is typically silt loam, silty clay loam, or loam. It is slightly acid to mildly alkaline. Stratification with varying soil colors and soil textures are in the C horizon of some pedons.

### Ortello Series

The Ortello soils consist of very deep, well drained, moderately rapidly permeable soils on uplands. These soils formed in loamy and sandy eolian and alluvial deposits. Slopes are 1 to 8 percent.

Typical pedon of Ortello sandy loam from an area of Wells-Ortello complex, 1 to 4 percent slopes, 2,300 feet east and 300 feet north of the southwest corner of sec. 17, T. 12 S., R. 5 E.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, nonplastic and nonsticky; many fine roots throughout; neutral; clear smooth boundary.

A—6 to 15 inches; dark grayish brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, friable, nonplastic and nonsticky; many fine roots throughout; neutral; gradual smooth boundary.

Bw—15 to 34 inches; brown (7.5YR 5/4) sandy loam, brown (7.5YR 4/4) moist; weak fine subangular blocky structure; soft, friable, nonplastic and nonsticky; few very fine roots throughout; neutral; gradual smooth boundary.

C—34 to 60 inches; light brown (7.5YR 6/4) sandy loam, strong brown (7.5YR 5/4) moist; massive; soft, friable, nonplastic and nonsticky; mildly alkaline.

The mollic epipedon ranges from 8 to 20 inches in thickness. The depth to free carbonates is generally below 60 inches.

The A horizon has value 3 to 5 (2 or 3 moist) and chroma of 2 or 3. It is typically sandy loam, but the range includes fine sandy loam and loam. Reaction is slightly acid or neutral.

The Bw horizon has value 4 to 6 (3 to 5 moist) and chroma of 2 to 4. It is sandy loam or fine sandy loam. Reaction is slightly acid or neutral.

The C horizon has hue of 7.5YR or 10YR, value of 5 to 8 (4 to 6 moist), and chroma of 2 to 4. It is typically sandy loam, but the range includes loamy fine sand, loamy sand, and fine sand. Reaction is neutral or mildly alkaline.

### Reading Series

The Reading series consists of very deep, well drained, moderately slowly permeable soils on high flood plains. These soils formed in silty alluvium.

Slopes range from 0 to 2 percent.

Typical pedon of Reading silty clay loam, 0 to 2 percent slopes, 600 feet south and 175 feet east of the northwest corner of sec. 9, T. 12 S., R. 8 E.

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) silty clay loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable, slightly plastic and slightly sticky; common fine and medium roots; slightly acid; clear smooth boundary.

A—8 to 20 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable, slightly plastic and slightly sticky; common fine roots; slightly acid; clear smooth boundary.

Bt1—20 to 52 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; firm, hard, plastic and sticky; few thin continuous clay films on faces of peds; few fine roots; slightly acid; gradual smooth boundary.

Bt2—52 to 60 inches; yellowish brown (10YR 5/4) silty clay loam, dark yellowish brown (10YR 4/4) moist; few fine distinct brownish yellow (10YR 6/8) mottles; weak fine subangular blocky structure; hard, firm, plastic and sticky; few thin clay films on faces of peds; few fine roots; slightly acid.

The mollic epipedon is more than 24 inches thick. The A horizon has value of 3 to 5 (2 or 3) moist and chroma of 1 to 3. It is typically silty clay loam or silt loam. It is medium acid or slightly acid.

The Bt horizon has hue of 10YR or 7.5YR, value of 3 to 5 (2 to 4 moist), and chroma of 2 to 4. It is silty clay loam. It is typically medium acid or slightly acid.

### Sarpy Series

The Sarpy series consists of very deep, excessively drained, rapidly permeable soils on flood plains. These soils formed in sandy alluvium. Slopes range from 0 to 4 percent.

Typical pedon of Sarpy loamy fine sand, 2 to 4 percent slopes, occasionally flooded, 3,200 feet east and 1,500 feet south of the northwest corner of sec. 28, T. 11 S., R. 5 E.

Ap—0 to 9 inches; grayish brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak fine granular structure; slightly hard, very friable, nonplastic and nonsticky; few fine roots throughout; neutral; abrupt smooth boundary.

C—9 to 60 inches; pale brown (10YR 6/3) fine sand, brown (10YR 5/3) moist; single grain; loose, nonplastic and nonsticky; few very fine roots throughout; mildly alkaline.

Reaction is neutral or mildly alkaline throughout the profile. The A horizon has value of 4 to 6 (3 to 5 moist) and chroma of 2 or 3. It is typically loamy fine sand, but the range includes fine sand and gravelly loamy sand.

The C horizon has value of 5 or 6 (4 to 6 moist) and chroma of 2 to 4. It is fine sand, loamy fine sand, or loamy sand. Some pedons have thin strata of finer textured material below a depth of 40 inches.

## Smokyhill Series

The Smokyhill series consists of very deep, moderately well drained soils on flood plains. These soils formed in clayey alluvium over silty alluvium. They are slowly permeable in the upper part and moderately permeable in the lower part. Slopes are 0 to 1 percent.

Typical pedon of Smokyhill silt loam, from an area of McCook-Smokyhill complex, occasionally flooded, 2,600 feet south and 1,500 feet east of the northwest corner of sec. 33, T. 12 S., R. 5 E.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots throughout; very slightly effervescent; mildly alkaline; clear smooth boundary.

A—6 to 14 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, friable, sticky and plastic; common very fine and fine roots throughout; slightly effervescent; mildly alkaline; clear smooth boundary.

AC—14 to 30 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium subangular blocky structure; hard, firm, sticky and plastic; common very fine roots throughout; strongly effervescent; mildly alkaline; clear smooth boundary.

2C—30 to 72 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and

nonplastic; common very fine tubular pores; strongly effervescent; mildly alkaline.

The thickness of the mollic epipedon ranges from 20 to 34 inches. The soils typically have free carbonates throughout.

The A horizon has value of 3 or 4 (2 or 3 moist) and chroma of 2 or 3. It is silt loam or silty clay loam. Reaction is neutral or mildly alkaline.

The AC horizon has value of 3 to 5 (3 or 4 moist) and chroma of 2 or 3. It is silty clay loam. Reaction is mildly or moderately alkaline.

The 2C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 or 3. It is dominantly silt loam, but thin strata of finer or coarser textured sediments are in some pedons. Reaction is mildly or moderately alkaline.

## Sogn Series

The Sogn series consists of shallow and very shallow, somewhat excessively drained, moderately permeable soils on uplands. These soils formed in residuum derived from limestone. Slopes range from 5 to 20 percent.

Typical pedon of Sogn silty clay loam, in an area of Clime-Sogn silty clay loams, 5 to 20 percent slopes, 300 feet east and 50 feet south of the northwest corner of sec. 15, T. 12 S., R. 7 E.

A—0 to 9 inches; very dark gray (10YR 3/1) silty clay loam, black (10YR 2/1) moist; moderate medium granular structure; hard, friable; few fragments of weathered limestone in the lower 3 inches comprise less than 15 percent of the soil volume; strong effervescence; moderately alkaline; abrupt smooth boundary.

R—9 inches; level-bedded indurated limestone bedrock that has joints averaging about 18 inches apart and less than 1/4 inch wide; cracks filled with dark colored soil.

The depth to bedrock ranges from 4 to 20 inches. The soils range from slightly acid to moderately alkaline throughout.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 1 to 3. It is typically silty clay loam, but the range includes silt loam.

## Solomon Series

The Solomon series consists of very deep, poorly drained, very slowly permeable soils on flood plains. These soils formed in clayey alluvium. Slopes are 0 to 1 percent.

Typical pedon of Solomon silty clay, occasionally

flooded, 150 east and 150 feet south of the northwest corner of sec. 26, T. 12 S., R. 5 E.

Ap—0 to 8 inches; very dark gray (10YR 3/1) silty clay, black (10YR 2/1) moist; weak fine granular structure; very hard, very firm, very plastic and very sticky; common fine and medium roots; strongly effervescent; moderately alkaline; clear smooth boundary.

A—8 to 19 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; weak medium angular blocky structure; very hard, very firm, very plastic and very sticky; common fine and medium roots; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bg1—19 to 36 inches; gray (10YR 5/1) clay, dark gray (10YR 4/1) moist; few fine distinct dark brown (10YR 4/3) mottles; moderate medium subangular blocky structure; very hard, extremely firm, very plastic and very sticky; few pressure faces; cracks filled with dark material from above horizons; few fine roots; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bg2—36 to 50 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; common fine distinct yellowish brown (10YR 5/4) mottles; moderate medium subangular blocky structure; very hard, extremely firm, very plastic and very sticky; few pressure faces; few fine roots; strongly effervescent; moderately alkaline; gradual smooth boundary.

Bg3—50 to 60 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; common medium faint brown (10YR 5/3) mottles; moderate medium subangular blocky structure; very hard, extremely firm, very plastic and very sticky; few fine roots; strongly effervescent; moderately alkaline.

The thickness of the mollic epipedon ranges from 15 to more than 40 inches. The depth to free carbonates is less than 10 inches.

The A horizon has hue of 10YR or 2.5Y, value of 3 or 4 (2 or 3 moist), and chroma of 1 or 2. It is typically silty clay or clay. It is mildly alkaline or moderately alkaline.

The Bg horizon has hue of 10YR to 5Y, value of 3 to 5 (2 to 4 moist), and chroma of 1 or 2. It is clay or silty clay averaging 40 to 55 percent clay.

## Sutphen Series

The Sutphen series consists of very deep, moderately well drained, very slowly permeable soils

on flood plains. These soils formed in clayey alluvium. Slopes range from 0 to 2 percent.

Typical pedon of Sutphen silty clay, occasionally flooded, 2,900 feet west and 200 feet south of the northeast corner of sec. 23, T. 12 S., R. 5 E.

Ap—0 to 6 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; weak fine granular structure; very hard, very firm, very plastic and very sticky; few fine roots; slightly acid; clear smooth boundary.

A1—6 to 11 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; weak fine subangular blocky structure; very hard, very firm; few pressure faces; few fine roots; neutral; gradual smooth boundary.

A2—11 to 21 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure; very hard, very firm, very plastic and very sticky; few pressure faces; few fine roots; moderately alkaline; gradual smooth boundary.

AC—21 to 30 inches; dark gray and gray (10YR 4/1 and 10YR 5/1) clay, very dark gray and dark gray (10YR 3/1 and 10YR 4/1) moist; few fine distinct brown (10YR 5/3) mottles; moderate medium subangular blocky structure; very hard, extremely firm, very plastic and very sticky; common pressure faces; few fine roots; moderately alkaline; clear smooth boundary.

C1—30 to 40 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; common fine distinct light olive brown (2.5Y 5/4) mottles; weak medium subangular blocky structure; very hard, extremely firm, very plastic and very sticky; few pressure faces; few fine roots; few fine carbonate concretions; slightly effervescent; moderately alkaline; gradual smooth boundary.

C2—40 to 59 inches; light brownish gray (2.5Y 6/2) silty clay, grayish brown (2.5Y 5/2) moist; common medium distinct light olive brown (2.5Y 5/4) mottles; weak medium subangular blocky structure; very hard, very firm, very plastic and very sticky; few pressure faces; few very fine roots; few fine carbonate concretions; strongly effervescent; moderately alkaline; gradual smooth boundary.

C3—59 to 60 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; common medium distinct light olive brown (2.5Y 5/4) mottles; weak medium subangular blocky structure; very hard, very firm, very plastic and very sticky; moderately alkaline.

The thickness of the mollic epipedon ranges from 24 to 48 inches. The depth to free carbonates ranges from 15 to 36 inches.

The A and AC horizons have hue of 10YR or 2.5Y, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. They are typically silty clay, but the range includes clay. Reaction is slightly acid to moderately alkaline.

The C horizon has hue of 10YR to 5Y, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. It is typically clay or silty clay. Reaction is mildly alkaline or moderately alkaline.

## Tully Series

The Tully series consists of very deep, well drained, slowly permeable soils on uplands. These soils formed in colluvium. Slopes range from 1 to 8 percent.

Typical pedon of Tully silty clay loam, 3 to 8 percent slopes, 250 feet east and 600 feet north of the southwest corner of sec. 4, T. 12 S., R. 8 E.

- A—0 to 12 inches; very dark grayish brown (10YR 3/2) silty clay loam, very dark brown (10YR 2/2) moist; moderate medium granular structure; slightly hard, friable, plastic and sticky; many fine and medium roots throughout; neutral; gradual smooth boundary.
- BA—12 to 21 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate fine subangular blocky structure; slightly hard, friable, plastic and sticky; many fine and medium roots throughout; slightly acid; gradual smooth boundary.
- Bt1—21 to 31 inches; brown (7.5YR 4/2) silty clay, dark brown (7.5YR 3/2) moist; moderate fine subangular blocky structure; hard, firm, very plastic and very sticky; few continuous clay films on faces of peds; common fine roots throughout; slightly acid; gradual smooth boundary.
- Bt2—31 to 40 inches; brown (7.5YR 4/4) silty clay, dark brown (7.5YR 3/4) moist; moderate medium subangular blocky structure; very hard, very firm, very plastic and very sticky; few continuous clay films on faces of peds; few fine roots throughout; slightly acid; gradual smooth boundary.
- Bt3—40 to 52 inches; brown (7.5YR 4/4) silty clay, dark brown (7.5YR 3/4) moist; few fine faint dark brown (7.5YR 4/4) mottles; weak medium subangular blocky structure; very hard, very firm, very plastic and very sticky; few continuous clay films on faces of peds; few fine roots; few fine black concretions; few fine chert fragments; neutral; gradual smooth boundary.
- BC—52 to 60 inches; yellowish brown (10YR 5/4) silty clay, dark yellowish brown (10YR 4/4) moist; few

fine faint dark brown (7.5YR 4/4) mottles; weak medium subangular blocky structure; very hard, very firm, very plastic and very sticky; few fine roots; few fine chert fragments; mildly alkaline.

The mollic epipedon ranges from 20 to more than 40 inches in thickness. The depth to free carbonates ranges from 30 to more than 60 inches.

The A horizon has hue of 10YR or 7.5YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 to 3. It is typically silty clay loam, but the range includes silt loam. Reaction ranges from medium acid to neutral.

The Bt horizon has hue of 10YR or 7.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. It is silty clay or silty clay loam. Reaction ranges from slightly acid to moderately alkaline. Some pedons contain mottles.

The C horizon has hue of 10YR to 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 6. It is silty clay or silty clay loam. Reaction ranges from neutral to moderately alkaline.

## Valentine Series

The Valentine series consists of very deep, excessively drained, rapidly permeable soils on uplands. These soils formed in wind deposited sandy material. Slopes range from 5 to 15 percent.

Typical pedon of Valentine loamy fine sand, 5 to 15 percent slopes, 2,000 feet east and 1,300 feet north of the southwest corner of sec. 9, T. 12 S., R. 5 E.

- A—0 to 5 inches; grayish brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, nonplastic and nonsticky; many fine roots; neutral; clear smooth boundary.
- C1—5 to 50 inches; pale brown (10YR 6/3) loamy sand, brown (10YR 5/3) moist; weak fine granular structure; loose, nonplastic and nonsticky; common fine roots; neutral; gradual smooth boundary.
- C2—50 to 60 inches; pale brown (10YR 6/3) sand, brown (10YR 5/3) moist; single grain; loose, nonplastic and nonsticky; neutral.

Reaction ranges from medium acid to neutral throughout the profile. The A horizon has value of 4 to 6 (3 to 5 moist) and chroma of 2 or 3. It is typically loamy fine sand, but the range includes loamy sand and sand.

The C horizon has value of 6 or 7 (5 or 6 moist) and chroma of 2 to 4. It is typically loamy sand or sand, but the range includes loamy fine sand and very fine sand.

## Wells Series

The Wells series consists of very deep, well drained, moderately permeable soils on uplands. These soils formed in noncalcareous old alluvial deposits. Slopes range from 1 to 8 percent.

Typical pedon of Wells loam, from an area of Wells-Ortello complex, 4 to 8 percent slopes, 1,000 feet east and 2,500 feet north of the southwest corner of sec. 17, T. 12 S., R. 5 E.

A—0 to 12 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable, slightly plastic and slightly sticky; many fine roots throughout; slightly acid; clear smooth boundary.

BA—12 to 19 inches; dark grayish brown (10YR 4/2) clay loam, dark brown (10YR 3/3) moist; moderate fine subangular blocky structure; slightly hard, friable, plastic and sticky; many fine roots throughout; slightly acid; gradual smooth boundary.

Bt1—19 to 37 inches; brown (7.5YR 4/4) clay loam, dark brown (7.5YR 3/4) moist; moderate fine subangular blocky structure; slightly hard, friable, plastic and sticky; few distinct dark brown (7.5YR 3/2) clay films on faces of peds;

few fine roots throughout; neutral; gradual smooth boundary.

Bt2—37 to 51 inches; brown (7.5YR 4/4) sandy clay loam, dark brown (7.5YR 3/4) moist; weak fine and medium subangular blocky structure; slightly hard, firm, plastic and sticky; few distinct dark brown (7.5YR 3/2) clay films on faces of peds; few very fine roots throughout; neutral; clear smooth boundary.

BC—51 to 63 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; slightly hard, firm, plastic and sticky; slightly acid.

The mollic epipedon ranges from 10 to 20 inches in thickness. The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 (2 or 3 moist), and chroma of 1 to 3. It is typically loam, but the range includes fine sandy loam. This horizon is medium acid or slightly acid.

The Bt horizon has hue of 7.5YR or 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 3 to 6. It is clay loam or sandy clay loam. Reaction is slightly acid or neutral.

The BC horizon has hue of 7.5YR or 5YR, value of 4 to 7 (5 or 6 moist), and chroma of 4 to 8. It is clay loam, sandy loam, or loam. Reaction is slightly acid to mildly alkaline.

# References

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- (1) American Association of State Highway and Transportation Officials. 1986. Standard specifications for highway materials and methods of sampling and testing. Ed. 14, 2 vols.
- (2) American Society for Testing and Materials. 1993. Standard classification of soils for engineering purposes. ASTM Stand. D 2487.
- (3) Austin, Morris E. 1965. Land resource regions and major land resource areas of the United States. U.S. Dep. Agric. Handb. 296.
- (4) Dunmire, Ralph G., and O.W. Bidwell. 1960. Soil survey of Geary County, Kansas. U.S. Dep. Agric., Soil Conserv. Serv.
- (5) Jantz, Donald R., Rodney F. Harner, Harold T. Rowland, and Donald A. Gier. 1975. Soil survey of Riley County and part of Geary County, Kansas. U.S. Dep. Agric., Soil Conserv. Serv.
- (6) Kansas State Board of Agriculture. 1989. 1988-1989 Farm facts. Spec. Rep. Kans. Crop and Kansas, Cattle Mark. Stat.
- (7) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436.
- (8) United States Department of Agriculture. 1993. Soil survey manual. U.S. Dep. Agric. Handb. 18.
- (9) United States Department of Agriculture, Soil Conservation Service. 1982. National resources inventory. (Available in the State Office of the Natural Resources Conservation Service at Salina, Kansas)



# Glossary

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**Aggregate, soil.** Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

**Alkali (sodic) soil.** A soil having so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

**Alluvium.** Material, such as sand, silt, or clay, deposited on land by streams.

**Area reclaim** (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

**Association, soil.** A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

**Available water capacity (available moisture capacity).** The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as:

Very low .....	0 to 3
Low .....	3 to 6
Moderate .....	6 to 9
High .....	9 to 12
Very high .....	more than 12

**Base saturation.** The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, and K), expressed as a percentage of the total cation-exchange capacity.

**Bedrock.** The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

**Bottom land.** The normal flood plain of a stream, subject to flooding.

**Calcareous soil.** A soil containing enough calcium

carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

**Cation.** An ion carrying a positive charge of electricity. The common soil cations are calcium, potassium, magnesium, sodium, and hydrogen.

**Chiseling.** Tillage with an implement having one or more soil-penetrating points that shatter or loosen hard, compacted layers to a depth below normal plow depth.

**Clay.** As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

**Clay film.** A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

**Claypan.** A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

**Climax vegetation.** The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

**Coarse fragments.** If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

**Coarse textured soil.** Sand or loamy sand.

**Cobblestone (or cobble).** A rounded or partly rounded fragment of rock 3 to 10 inches (7.6 to 25 centimeters) in diameter.

**Colluvium.** Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

**Complex slope.** Irregular or variable slope. Planning or establishing terraces, diversions, and other water-control structures on a complex slope is difficult.

**Complex, soil.** A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the

selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

**Concretions.** Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

**Conservation tillage.** A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

**Consistence, soil.** The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are:

*Loose.*—Noncoherent when dry or moist; does not hold together in a mass.

*Friable.*—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

*Firm.*—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

*Plastic.*—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a “wire” when rolled between thumb and forefinger.

*Sticky.*—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

*Hard.*—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

*Soft.*—When dry, breaks into powder or individual grains under very slight pressure.

*Cemented.*—Hard; little affected by moistening.

**Contour stripcropping.** Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

**Control section.** The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

**Cover crop.** A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

**Cutbanks cave** (in tables). The walls of excavations tend to cave in or slough.

**Decreasers.** The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

**Deferred grazing.** Postponing grazing or resting grazing land for a prescribed period.

**Depth to rock** (in tables). Bedrock is too near the surface for the specified use.

**Diversion (or diversion terrace).** A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

**Drainage class** (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

*Excessively drained.*—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

*Somewhat excessively drained.*—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

*Well drained.*—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

*Moderately well drained.*—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum or periodically receive high rainfall, or both.

*Somewhat poorly drained.*—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

*Poorly drained.*—Water is removed so slowly that the soil is saturated periodically during the growing

season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

*Very poorly drained.*—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

**Drainage, surface.** Runoff, or surface flow of water, from an area.

**Eolian soil material.** Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

**Erosion.** The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

*Erosion* (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

*Erosion* (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of human or animal activities or of a catastrophe in nature, for example, fire, that exposes the surface.

**Excess fines** (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

**Fallow.** Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

**Fast intake** (in tables). The rapid movement of water into the soil.

**Fertility, soil.** The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

**Fine textured soil.** Sandy clay, silty clay, or clay.

**Flood plain.** A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

**Foot slope.** The inclined surface at the base of a hill.

**Forb.** Any herbaceous plant not a grass or a sedge.

**Frost action** (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

**Genesis, soil.** The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

**Grassed waterway.** A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

**Gravel.** Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

**Ground water** (geology). Water filling all the unblocked pores of the material below the water table.

**Gully.** A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

**Horizon, soil.** A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

*O horizon.*—An organic layer of fresh and decaying plant residue.

*A horizon.*—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

*E horizon.*—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

*B horizon.*—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than

those in the A horizon; or (4) a combination of these.

**C horizon.**—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

**Cr horizon.**—Soft, consolidated bedrock beneath the soil.

**R layer.**—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

**Hydrologic soil groups.** Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

**Illuviation.** The movement of soil material from one horizon to another in the soil profile. Generally, material is removed from an upper horizon and deposited in a lower horizon.

**Increasers.** Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and are less palatable to livestock.

**Infiltration.** The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

**Invaders.** On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

**Large stones** (in tables). Rock fragments 3 inches (7.6 centimeters) or more across. Large stones adversely affect the specified use of the soil.

**Liquid limit.** The moisture content at which the soil passes from a plastic to a liquid state.

**Loess.** Fine grained material, dominantly of silt-sized particles, deposited by the wind.

**Low strength.** The soil is not strong enough to support loads.

**Miscellaneous area.** An area that has little or no natural soil and supports little or no vegetation.

**Morphology, soil.** The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

**Mottling, soil.** Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few*, *common*, and *many*; size—*fine*, *medium*, and *coarse*; and contrast—*faint*, *distinct*, and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

**Munsell notation.** A designation of color by degrees of three simple variables—hue, value, and chroma.

For example, a notation of 10YR 6/4 is a color with hue of 10YR, value of 6, and chroma of 4.

**Neutral soil.** A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

**Organic matter.** Plant and animal residue in the soil in various stages of decomposition.

**Parent material.** The unconsolidated organic and mineral material in which soil forms.

**Ped.** An individual natural soil aggregate, such as a granule, a prism, or a block.

**Pedon.** The smallest volume that can be called “a soil.” A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

**Percolation.** The downward movement of water through the soil.

**Percs slowly** (in tables). The slow movement of water through the soil, adversely affecting the specified use.

**Permeability.** The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow .....	less than 0.06 inch
Slow .....	0.06 to 0.2 inch
Moderately slow .....	0.2 to 0.6 inch
Moderate .....	0.6 inch to 2.0 inches
Moderately rapid .....	2.0 to 6.0 inches
Rapid .....	6.0 to 20 inches
Very rapid .....	more than 20 inches

**Phase, soil.** A subdivision of a soil series based on features that affect its use and management, such as slope, stoniness, and thickness.

**pH value.** A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

**Piping** (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

**Plasticity index.** The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

**Plastic limit.** The moisture content at which a soil changes from semisolid to plastic.

**Ponding.** Standing water on soils in closed depressions. Unless the soils are artificially drained, the water can be removed only by percolation or evapotranspiration.

**Poor filter** (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

**Productivity, soil.** The capability of a soil for producing a specified plant or sequence of plants under specific management.

**Profile, soil.** A vertical section of the soil extending through all its horizons and into the parent material.

**Range condition.** The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor on the basis of how much the present plant community has departed from the potential.

**Rangeland.** Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

**Range site.** An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

**Reaction, soil.** A measure of acidity or alkalinity of a

soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degrees of acidity or alkalinity, expressed as pH values, are:

Extremely acid .....	below 4.5
Very strongly acid .....	4.5 to 5.0
Strongly acid .....	5.1 to 5.5
Medium acid .....	5.6 to 6.0
Slightly acid .....	6.1 to 6.5
Neutral .....	6.6 to 7.3
Mildly alkaline .....	7.4 to 7.8
Moderately alkaline .....	7.9 to 8.4
Strongly alkaline .....	8.5 to 9.0
Very strongly alkaline .....	9.1 and higher

**Relief.** The elevations or inequalities of a land surface, considered collectively.

**Residuum (residual soil material).** Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock is integrated in place.

**Rock fragments.** Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

**Rooting depth** (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

**Runoff.** The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

**Saline soil.** A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

**Sand.** As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

**Seepage** (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

**Series, soil.** A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

**Shale.** Sedimentary rock formed by the hardening of a clay deposit.

**Sheet erosion.** The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and surface runoff.

**Shrink-swell.** The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

**Similar soils.** Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

**Slickensides.** Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

**Slick spot.** A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

**Slope.** The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

**Slope** (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

**Slow intake** (in tables). The slow movement of water into the soil.

**Small stones** (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

**Soil.** A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

**Soil separates.** Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand .....	2.0 to 1.0
Coarse sand .....	1.0 to 0.5
Medium sand .....	0.5 to 0.25
Fine sand .....	0.25 to 0.10
Very fine sand .....	0.10 to 0.05
Silt .....	0.05 to 0.002
Clay .....	less than 0.002

**Solum.** The upper part of a soil profile, above the C

horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the substratum. The living roots and plant and animal activities are largely confined to the solum.

**Stones.** Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter if rounded or 15 to 24 inches (38 to 60 centimeters) in length if flat.

**Stony.** Refers to a soil containing stones in numbers that interfere with or prevent tillage.

**Strippcropping.** Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to soil blowing and water erosion.

**Structure, soil.** The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

**Subsoil.** Technically, the B horizon; roughly, the part of the solum below plow depth.

**Substratum.** The part of the soil below the solum.

**Subsurface layer.** Any surface soil horizon (A, E, AB, or EB) below the surface layer.

**Surface layer.** The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

**Surface soil.** The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

**Terrace.** An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

**Terrace** (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

**Texture, soil.** The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand*, *loamy sand*, *sandy loam*, *loam*, *silt loam*, *silt*, *sandy clay loam*, *clay loam*, *silty clay loam*, *sandy clay*, *silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

**Thin layer** (in tables). A layer of otherwise suitable soil material that is too thin for the specified use.

**Tilth, soil.** The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

**Topsoil.** The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

**Upland** (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

**Weathering.** All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.



# Tables

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Table 1.--Temperature and Precipitation  
(Recorded in the period 1965-87 at Milford, Kansas)

	Temperature						Precipitation				
Month				2 years in 10 will have--		Average		2 years in 10 will have--		Average	
	Average	Average	Average	Maximum	Minimum	number of	Average	Less	More	number of	Average
	daily	daily	daily	temperature	temperature	growing		than--	than--	days with	snowfall
	maximum	minimum		higher than--	lower than--	degree days*				0.10 inch or more	
	<u>F</u>	<u>F</u>	<u>F</u>	<u>F</u>	<u>F</u>	<u>Units</u>	<u>In</u>	<u>In</u>	<u>In</u>		<u>In</u>
January-----	35.3	14.0	24.7	67	11	0	0.70	0.13	1.14	2	6.3
February-----	42.0	19.2	30.6	75	11	22	.82	.25	1.27	2	4.3
March-----	54.6	30.1	42.4	83	6	49	2.37	.69	3.75	4	1.3
April-----	65.9	41.7	53.8	89	21	167	2.95	1.57	4.16	5	.6
May-----	74.8	51.1	63.0	91	35	411	4.47	2.60	6.13	7	.0
June-----	84.4	60.8	72.6	101	44	678	4.59	2.74	6.23	6	.0
July-----	91.1	66.6	78.9	105	52	896	3.69	.72	5.98	5	.0
August-----	88.8	64.2	76.5	104	52	822	3.15	1.22	4.79	5	.0
September---	80.3	55.2	67.8	99	35	534	4.03	1.69	6.01	5	.0
October-----	68.6	42.9	55.8	91	25	200	2.85	.94	4.40	5	.0
November-----	53.3	31.3	42.3	78	11	12	1.53	.22	2.52	3	.8
December-----	40.7	20.3	30.5	67	11	9	1.17	.31	1.87	2	2.9
Yearly:											
Average---	65.0	41.5	53.2	---	---	---	---	---	---	---	---
Extreme---	---	---	---	107	11	---	---	---	---	---	---
Total-----	---	---	---	---	---	3,800	32.32	25.40	38.48	51	16.2

\* A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which

Table 2.--Freeze Dates in Spring and Fall  
(Recorded in the period 1965-87 at Milford, Kansas)

Probability	Temperature		
	24 °F or lower	28 °F or lower	32 °F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 14	Apr. 19	May 1
2 years in 10 later than--	Apr. 8	Apr. 14	Apr. 27
5 years in 10 later than--	Mar. 27	Apr. 6	Apr. 18
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 22	Oct. 11	Sept. 29
2 years in 10 earlier than--	Oct. 30	Oct. 16	Oct. 5
5 years in 10 earlier than--	Nov. 13	Oct. 27	Oct. 16

Table 3.--Growing Season  
(Recorded in the period 1965-87 at Milford,  
Kansas)

Probability	Daily minimum temperature during growing season		
	Higher than 24 °F	Higher than 28 °F	Higher than 32 °F
	<u>Days</u>	<u>Days</u>	<u>Days</u>
9 years in 10	201	184	155
8 years in 10	211	190	164
5 years in 10	230	204	181
2 years in 10	248	217	198
1 year in 10	258	224	207

Table 4.--Acreage and Proportionate Extent of the Soils

Map symbol	Soil name	Acres	Percent
Be	Benfield-Florence complex, 5 to 30 percent slopes-----	41,290	16.0
Cc	Clime silty clay loam, 20 to 40 percent slopes, stony-----	8,190	3.2
Cf	Clime-Sogn silty clay loams, 5 to 20 percent slopes-----	49,090	19.0
Cr	Crete silty clay loam, 0 to 1 percent slopes-----	440	0.2
Cs	Crete silty clay loam, 1 to 4 percent slopes-----	7,290	2.8
Ct	Crete silty clay loam, 3 to 8 percent slopes-----	14,360	5.6
Bu	Eudora silt loam, occasionally flooded-----	3,240	1.3
Ge	Geary silt loam, 3 to 8 percent slopes-----	4,820	1.9
Gf	Geary silt loam, 7 to 15 percent slopes-----	2,820	1.1
He	Haynie silt loam, frequently flooded-----	2,190	0.8
Hf	Hobbs silt loam, channeled-----	240	0.1
Hg	Hobbs silt loam, occasionally flooded-----	2,070	0.8
Hm	Holder silt loam, 1 to 3 percent slopes-----	1,300	0.5
Ho	Holder silt loam, 3 to 7 percent slopes-----	2,370	0.9
Id	Irwin silty clay loam, 3 to 7 percent slopes-----	16,990	6.6
Ka	Kahola silt loam, channeled-----	2,210	0.9
Kb	Kahola silt loam, occasionally flooded-----	8,790	3.4
Ko	Konza silty clay loam, 1 to 3 percent slopes-----	27,190	10.5
Lm	Ladysmith silty clay loam, 0 to 2 percent slopes-----	4,950	1.9
Lo	Longford loam, 1 to 3 percent slopes-----	1,650	0.6
Mb	McCook silt loam, occasionally flooded-----	1,100	0.4
Mc	McCook silt loam, rarely flooded-----	1,140	0.4
Mk	McCook-Smokyhill silt loams, occasionally flooded-----	3,470	1.3
M-W	Miscellaneous water areas-----	20	*
Mu	Muir silt loam, rarely flooded-----	4,890	1.9
Oc	Orthents-----	550	0.2
Or	Orthents, earthen dam-----	100	*
Pt	Pits, quarries-----	390	0.2
Ra	Reading silt loam, 0 to 1 percent slopes-----	21	*
Re	Reading silty clay loam, 0 to 2 percent slopes-----	7,140	2.8
Sa	Sarpy loamy fine sand, 0 to 4 percent slopes, occasionally flooded-----	570	0.2
Sc	Sarpy gravelly loamy sand, 0 to 4 percent slopes, occasionally flooded-----	310	0.1
Sh	Solomon silty clay, occasionally flooded-----	760	0.3
St	Sutphen silty clay, occasionally flooded-----	930	0.4
Tn	Tully silty clay loam, 1 to 4 percent slopes-----	5,150	2.0
To	Tully silty clay loam, 3 to 8 percent slopes-----	11,760	4.5
Vc	Valentine loamy fine sand, 5 to 15 percent slopes-----	470	0.2
We	Wells-Ortello complex, 1 to 4 percent slopes-----	1,330	0.5
Wf	Wells-Ortello complex, 4 to 8 percent slopes-----	3,910	1.5
	Water-----	13,110	5.1
	Total-----	258,611	100.0

\* Less than 0.1 percent.

Table 5.--Prime Farmland

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
Cr	Crete silty clay loam, 0 to 1 percent slopes
Cs	Crete silty clay loam, 1 to 4 percent slopes
Eu	Eudora silt loam, occasionally flooded
Hg	Hobbs silt loam, occasionally flooded
Hm	Holder silt loam, 1 to 3 percent slopes
Ho	Holder silt loam, 3 to 7 percent slopes
Kb	Kahola silt loam, occasionally flooded
Ko	Konza silty clay loam, 1 to 3 percent slopes
Lm	Ladysmith silty clay loam, 0 to 2 percent slopes
Lo	Longford loam, 1 to 3 percent slopes
Mb	McCook silt loam, occasionally flooded
Mc	McCook silt loam, rarely flooded
Mk	McCook-Smokyhill silt loams, occasionally flooded
Mu	Muir silt loam, rarely flooded
Ra	Reading silt loam, 0 to 1 percent slopes
Re	Reading silty clay loam, 0 to 2 percent slopes
Sh	Solomon silty clay, occasionally flooded (where drained)
St	Sutphen silty clay, occasionally flooded
Tn	Tully silty clay loam, 1 to 4 percent slopes
We	Wells-Ortello complex, 1 to 4 percent slopes

Table 6.--Land Capability and Yields Per Acre of Crops and Pasture

(Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability	Winter wheat	Grain sorghum	Soybeans	Smooth brome grass	Alfalfa hay
		<u>Bu</u>	<u>Bu</u>	<u>Bu</u>	<u>AUM*</u>	<u>Tons</u>
Be----- Benfield-Florence	VIe	---	---	---	---	---
Cc----- Clime	VIIe	---	---	---	---	---
Cf----- Clime-Sogn	VIe	---	---	---	---	---
Cr----- Crete	IIs	38	64	---	---	3.2
Cs----- Crete	IIe	35	58	---	---	2.9
Ct----- Crete	IIIe	31	53	---	---	2.5
Eu----- Eudora	IIw	39	70	33	7.5	5.0
Ge----- Geary	IIIe	36	61	29	5.2	3.0
Gf----- Geary	VIe	---	---	---	4.8	---
He----- Haynie	Vw	---	---	---	4.6	---
Hf----- Hobbs	Vw	---	---	---	---	---
Hg----- Hobbs	IIw	46	77	33	---	4.0
Hm----- Holder	IIe	40	67	---	---	3.4
Ho----- Holder	IIIe	36	61	---	---	3.0
Id----- Irwin	IVe	29	57	25	5.0	2.6
Ka----- Kahola	Vw	---	---	---	---	---
Kb----- Kahola	IIw	46	77	---	9.0	5.0
Ko----- Konza	IIIe	29	47	---	---	---
Lm----- Ladysmith	IIs	36	60	28	5.0	3.0

See footnotes at end of table.

Table 6.--Land Capability and Yields Per Acre of Crops and Pasture--Continued

Soil name and map symbol	Land capability	Winter wheat	Grain sorghum	Soybeans	Smooth brome grass	Alfalfa hay
		<u>Bu</u>	<u>Bu</u>	<u>Bu</u>	<u>AUM*</u>	<u>Tons</u>
LO----- Longford	IIe	36	61	30	6.0	3.0
Mb----- McCook	IIw	36	61	---	---	2.8
MC----- McCook	I	39	63	---	---	3.0
Mk----- McCook-Smokyhill	IIw	35	60	---	---	---
Mu----- Muir	I	46	77	35	6.2	5.0
Oc----- Orthents	VIe	---	---	---	---	---
Pt**----- Pits, quarries	VIII	---	---	---	---	---
Ra----- Reading	I	45	73	35	6.5	5.0
Re----- Reading	I	44	72	35	6.5	4.5
Sa----- Sarpy	IVs	20	39	---	1.8	---
SC----- Sarpy	VI s	---	---	---	---	---
Sh----- Solomon	IIIw	22	45	---	5.5	3.0
St----- Sutphen	IIIw	36	61	---	5.0	2.9
Tn----- Tully	IIe	40	67	---	6.0	3.8
To----- Tully	IIIe	34	58	---	5.5	3.3
Vc----- Valentine	VIe	---	---	---	---	---
We----- Wells-Ortello	IIIe	37	63	---	5.1	3.5
Wf----- Wells-Ortello	IVe	34	58	---	5.1	3.1

\* Animal unit month: The amount of forage or feed required to feed one animal unit (one cow, one horse, one mule, five sheep, or five goats) for 30 days.

\*\* See description of the map unit for composition and behavior characteristics of the map unit.

Table 7.--Rangeland Productivity

(Only the soils that support rangeland vegetation suitable for grazing are listed)

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable <u>Lb/acre</u>	Average <u>Lb/acre</u>	Unfavorable <u>Lb/acre</u>
Be*:				
Benfield-----	Loamy Upland-----	6,000	4,500	3,000
Florence-----	Loamy Upland-----	5,500	4,500	3,500
Cc-----	Limy Upland-----	5,000	3,500	2,500
Clime				
Cf*:				
Clime-----	Limy Upland-----	5,000	3,500	2,500
Sogn-----	Shallow Limy-----	3,500	2,500	1,500
Cr, Cs, Ct-----	Clay Upland-----	4,500	4,100	3,700
Crete				
Eu-----	Loamy Lowland-----	10,000	8,000	6,000
Eudora				
Ge, Gf-----	Loamy Upland-----	6,000	4,000	3,000
Geary				
He-----	Loamy Lowland-----	5,300	4,900	4,500
Haynie				
Hf, Hg-----	Loamy Lowland-----	4,700	4,200	4,000
Hobbs				
Hm, Ho-----	Loamy Upland-----	4,800	4,400	4,000
Holder				
Id-----	Clay Upland-----	5,000	3,500	2,000
Irwin				
Ka, Kb-----	Loamy Lowland-----	10,000	8,000	6,000
Kahola				
Ko-----	Claypan-----	4,000	3,000	2,000
Konza				
@SV-----				
Im-----	Clay Upland-----	5,000	3,500	2,000
Ladysmith				
Lo-----	Loamy Upland-----	5,500	4,000	3,000
Longford				
Mb-----	Loamy Lowland-----	3,800	3,300	2,800
McCook				
Mc-----	Loamy Terrace-----	3,800	3,300	2,800
McCook				
Mk*:				
McCook-----	Loamy Lowland-----	3,800	3,300	2,800
Smokyhill-----	Clay Lowland-----	---	---	---

See footnote at end of table.

Table 7.--Rangeland Productivity--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season		
		Favorable	Average	Unfavorable
		<u>Lb/acre</u>	<u>Lb/acre</u>	<u>Lb/acre</u>
Mu----- Muir	Loamy Terrace-----	7,500	5,500	4,000
Ra, Re----- Reading	Loamy Lowland-----	10,000	8,000	6,000
Sa, Sc----- Sarpy	Sandy Lowland-----	3,800	3,500	3,000
Sh----- Solomon	Clay Lowland-----	7,500	5,500	3,500
St----- Sutphen	Clay Lowland-----	7,500	5,500	3,500
Tn, To----- Tully	Loamy Upland-----	6,000	5,000	3,500
Vc----- Valentine	Sandy-----	3,000	2,600	2,200
We*, Wf*: Wells-----	Loamy Upland-----	5,500	4,000	3,000
Ortello-----	Sandy-----	3,500	3,300	3,000

\* See description of the map unit for composition and behavior characteristics of the map unit.

Table 8.--Windbreaks and Environmental Plantings

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Be*:					
Benfield-----	Siberian peashrub, Peking cotoneaster, lilac.	Amur honeysuckle, Manchurian crabapple.	Eastern redcedar, Austrian pine, Russian-olive, hackberry, green ash.	Siberian elm, honeylocust.	---
Florence-----	Lilac, Peking cotoneaster, Amur honeysuckle, fragrant sumac.	---	Eastern redcedar, hackberry, bur oak, Austrian pine, green ash, Russian-olive.	Honeylocust, Siberian elm.	---
Cc----- Clime	Fragrant sumac----	Siberian peashrub	Eastern redcedar, green ash, Osage-orange, Russian-olive, black locust, honeylocust, northern catalpa, bur oak.	Siberian elm-----	---
Cf*:					
Clime-----	Fragrant sumac----	Siberian peashrub	Eastern redcedar, green ash, Osage-orange, Russian-olive, black locust, honeylocust, northern catalpa, bur oak.	Siberian elm-----	---
Sogn.					
Cr, Cs, Ct----- Crete	Lilac, Peking cotoneaster.	Manchurian crabapple, Amur honeysuckle, Austrian pine, Siberian peashrub.	Eastern redcedar, hackberry, Russian-olive, green ash.	Honeylocust, Siberian elm.	---
Eu----- Eudora	---	Lilac, Peking cotoneaster, Amur honeysuckle, American plum.	Eastern redcedar	Austrian pine, bur oak, honeylocust, hackberry, green ash, eastern white pine.	Eastern cottonwood.
Ge, Gf----- Geary	Peking cotoneaster	Lilac, fragrant sumac, Amur honeysuckle.	Eastern redcedar, hackberry, bur oak, green ash, Russian-olive.	Scotch pine, Austrian pine, honeylocust.	---
He----- Haynie	Blackhaw-----	Siberian peashrub	Russian-olive, Osage-orange, eastern redcedar, Washington hawthorn.	Green ash, hackberry, honeylocust, bur oak.	Eastern cottonwood.

See footnote at end of table.

Table 8.--Windbreaks and Environmental Plantings--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Hf, Hg----- Hobbs	---	American plum, Peking cotoneaster, lilac, Amur honeysuckle.	Eastern redcedar	Green ash, hackberry, Austrian pine, honeylocust, eastern white pine, bur oak.	Eastern cottonwood.
Hm, Ho----- Holder	Amur honeysuckle, lilac, fragrant sumac.	Russian mulberry	Eastern redcedar, Austrian pine, green ash, honeylocust, hackberry, bur oak, Russian- olive.	Siberian elm-----	---
Id----- Irwin	Lilac, Peking cotoneaster.	Manchurian crabapple, Amur honeysuckle, Siberian peashrub.	Austrian pine, eastern redcedar, hackberry, green ash, Russian- olive.	Siberian elm, honeylocust.	---
Ka, Kb----- Kahola	Blackhaw-----	Siberian peashrub	Russian-olive, eastern redcedar, Osage-orange, Washington hawthorn.	Honeylocust, hackberry, green ash, bur oak.	Eastern cottonwood.
Ko----- Konza	Siberian peashrub, lilac, Amur honeysuckle, Peking cotoneaster.	Eastern redcedar, Manchurian crabapple.	Austrian pine, green ash, honeylocust, Russian-olive, hackberry.	Siberian elm-----	---
Lm----- Ladysmith	Lilac, Peking cotoneaster.	Amur honeysuckle, Siberian peashrub, Manchurian crabapple.	Eastern redcedar, Austrian pine, Russian-olive, hackberry, green ash.	Siberian elm, honeylocust.	---
Lo----- Longford	Lilac, fragrant sumac, Amur honeysuckle.	Russian mulberry	Eastern redcedar, bur oak, honeylocust, green ash, Austrian pine, hackberry, Russian-olive.	Siberian elm-----	---
Mb, Mc----- McCook	American plum, lilac.	---	Eastern redcedar, ponderosa pine, Russian-olive, hackberry, green ash, Rocky Mountain juniper.	Honeylocust, Siberian elm.	Eastern cottonwood.

See footnote at end of table.

Table 8.--Windbreaks and Environmental Plantings--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Mt*: McCook-----	American plum, lilac.	---	Eastern redcedar, ponderosa pine, Russian-olive, hackberry, green ash, Rocky Mountain juniper.	Honeylocust, Siberian elm.	Eastern cottonwood.
Smokyhill-----	American plum-----	Eastern redcedar, lilac, Siberian peashrub, common chokecherry, fragrant sumac.	Green ash, Russian mulberry.	Siberian elm, hackberry, honeylocust.	Eastern cottonwood.
Mu----- Muir	---	Peking cotoneaster, Amur honeysuckle, American plum, lilac.	Eastern redcedar	Eastern white pine, honeylocust, bur oak, Austrian pine, green ash, hackberry.	Eastern cottonwood.
Oc. Orthents					
Pt*. Pits, quarries					
Ra, Re----- Reading	---	Lilac, American plum, Peking cotoneaster, Amur honeysuckle.	Eastern redcedar	Austrian pine, bur oak, green ash, honeylocust, eastern white pine, hackberry.	Eastern cottonwood.
Sa----- Sarpy	Blackhaw-----	Siberian peashrub	Washington hawthorn, Russian-olive, eastern redcedar, Osage-orange.	Bur oak, hackberry, green ash, honeylocust.	Eastern cottonwood.
Sc----- Sarpy	Blackhaw-----	Siberian peashrub, Washington hawthorn.	Eastern redcedar, Russian-olive, Osage-orange.	Bur oak, hackberry, green ash, honeylocust.	Eastern cottonwood.
Sh----- Solomon	Redosier dogwood	Common chokecherry, American plum.	Eastern redcedar, hackberry.	Northern red oak, Austrian pine, green ash, golden willow, honeylocust.	Eastern cottonwood.
St----- Sutphen	Amur honeysuckle, Siberian peashrub, Peking cotoneaster.	Eastern redcedar, hackberry, Russian-olive, green ash, Rocky Mountain juniper.	Austrian pine, Russian mulberry, honeylocust.	Siberian elm-----	---
Tn, To----- Tully	Lilac, Peking cotoneaster.	Manchurian crabapple, Amur honeysuckle, Siberian peashrub.	Austrian pine, eastern redcedar, hackberry, green ash, Russian- olive.	Siberian elm, honeylocust.	---

See footnote at end of table.

Table 8.--Windbreaks and Environmental Plantings--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Vc----- Valentine	---	Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine, Austrian pine, jack pine.	---	---
We*, WF*: Wells-----	Peking cotoneaster	Fragrant sumac, Amur honeysuckle, lilac.	Russian-olive, eastern redcedar, hackberry, bur oak, green ash.	Austrian pine, Scotch pine, honeylocust.	---
Ortello-----	Skunkbush sumac---	American plum, Siberian peashrub, lilac.	Eastern redcedar, honeylocust, ponderosa pine, Russian-olive, hackberry, green ash.	---	Siberian elm.

\* See description of the map unit for composition and behavior characteristics of the map unit.

Table 9.--Recreational Development

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Be*: Benfield-----  Florence.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
Cc----- Clime	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Cf*: Clime-----  Sogn-----	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.
	Severe: thin layer, area reclaim.	Severe: thin layer, area reclaim.	Severe: slope, thin layer, area reclaim.	Slight.
Cr----- Crete	Slight-----	Slight-----	Slight-----	Severe: erodes easily.
Cs, Ct----- Crete	Slight-----	Slight-----	Moderate: slope.	Severe: erodes easily.
Eu----- Eudora	Severe: flooding.	Slight-----	Moderate: flooding.	Slight.
Ge----- Geary	Slight-----	Slight-----	Moderate: slope.	Slight.
Gf----- Geary	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
He----- Haynie	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
Hf----- Hobbs	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
Hg----- Hobbs	Severe: flooding.	Slight-----	Moderate: flooding.	Slight.
Hm, Ho----- Holder	Slight-----	Slight-----	Moderate: slope.	Slight.
Id----- Irwin	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight.
Ka, Kb----- Kahola	Severe: flooding.	Slight-----	Moderate: flooding.	Slight.
Ko----- Konza	Moderate: percs slowly.	Moderate: percs slowly.	Moderate: slope, percs slowly.	Slight.

See footnote at end of table.

Table 9.--Recreational Development--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Im----- Ladysmith	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Moderate: wetness, percs slowly.	Slight.
Lo----- Longford	Slight-----	Slight-----	Moderate: slope.	Slight.
Mb----- McCook	Severe: flooding.	Slight-----	Moderate: flooding.	Slight.
Mc----- McCook	Severe: flooding.	Slight-----	Slight-----	Slight.
Mk*: McCook-----	Severe: flooding.	Slight-----	Moderate: flooding.	Slight.
Smokyhill-----	Severe: flooding.	Slight-----	Moderate: flooding.	Slight.
Mu----- Muir	Severe: flooding.	Slight-----	Slight-----	Slight.
Oc----- Orthents	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
Pt*. Pits, quarries				
Ra, Re----- Reading	Severe: flooding.	Moderate: percs slowly.	Moderate: percs slowly.	Slight.
Sa----- Sarpy	Severe: flooding.	Slight-----	Moderate: slope, flooding.	Slight.
Sc----- Sarpy	Severe: flooding.	Moderate: too sandy, small stones.	Severe: small stones.	Moderate: large stones, too sandy.
Sh----- Solomon	Severe: flooding, wetness, percs slowly.	Severe: wetness, too clayey, percs slowly.	Severe: too clayey, wetness.	Severe: wetness, too clayey.
St----- Sutphen	Severe: flooding.	Moderate: too clayey, percs slowly.	Moderate: too clayey, flooding, percs slowly.	Moderate: too clayey.
Tn, To----- Tully	Slight-----	Slight-----	Moderate: slope.	Severe: erodes easily.
Vc----- Valentine	Moderate: slope, too sandy.	Moderate: slope, too sandy.	Severe: slope.	Moderate: too sandy.

See footnote at end of table.

Table 9.--Recreational Development--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
We*: Wells-----	Slight-----	Slight-----	Moderate: slope.	Slight.
Ortello-----	Slight-----	Slight-----	Moderate: slope.	Slight.
Wf*: Wells-----	Slight-----	Slight-----	Severe: slope.	Slight.
Ortello-----	Slight-----	Slight-----	Severe: slope.	Slight.

\* See description of the map unit for composition and behavior characteristics of the map unit.

Table 10.--Wildlife Habitat

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hard- wood trees	Conif- erous plants	Shrubs	Wetland plants	Shallow water areas	Open- land wild- life	Wood- land wild- life	Wetland wild- life	Range- land wild- life
Be*:												
Benfield-----	Poor	Fair	Fair	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Florence-----	Poor	Good	Fair	---	---	Fair	Poor	Very poor.	Fair	---	Very poor.	Fair.
Cc-----	Poor	Fair	Fair	---	---	Poor	---	Poor	Fair	---	Very poor.	Fair.
Clime												
Cf*:												
Clime-----	Fair	Fair	Good	---	---	Fair	Very poor.	Very poor.	Fair	---	Very poor.	Fair.
Sogn-----	Very poor.	Very poor.	Poor	---	---	Poor	Very poor.	Very poor.	Very poor.	---	Very poor.	Poor.
Cr, Cs-----	Good	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
Crete												
Ct-----	Fair	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Good.
Crete												
Eu-----	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.
Eudora												
Ge, Gf-----	Fair	Good	Good	Fair	Fair	Fair	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
Geary												
He-----	Fair	Fair	Fair	Fair	Poor	---	Poor	Poor	Fair	Fair	Poor	---
Haynie												
Hf-----	Poor	Fair	Fair	Fair	Fair	Fair	Very poor.	Very poor.	Fair	Fair	Very poor.	Fair.
Hobbs												
Hg-----	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	Good.
Hobbs												
Hm-----	Good	Good	Good	Good	Fair	Fair	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Holder												
Ho-----	Fair	Good	Good	Good	Fair	Fair	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Holder												
Id-----	Fair	Good	Good	---	---	Fair	Poor	Poor	Fair	---	Poor	Fair.
Irwin												
Ka-----	Poor	Fair	Fair	Good	Good	Good	Poor	Fair	Fair	Good	Poor	Good.
Kahola												
Kb-----	Good	Good	Good	Good	Good	Good	Poor	Fair	Good	Good	Poor	Good.
Kahola												

See footnote at end of table.

Table 10.--Wildlife Habitat--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hard- wood trees	Conif- erous plants	Shrubs	Wetland plants	Shallow water areas	Open- land wild- life	Wood- land wild- life	Wetland wild- life	Range- land wild- life
Ko----- Konza	Good	Good	Good	---	---	Good	Poor	Poor	Good	---	Poor	Good.
Im----- Ladysmith	Fair	Good	Good	---	---	Good	Poor	Fair	Good	---	Poor	Good.
Lo----- Longford	Good	Good	Fair	---	---	Fair	Poor	Fair	Good	---	Poor	Fair.
Mb, Mc----- McCook	Good	Good	Good	Good	Fair	Good	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
Mk*: McCook-----	Good	Good	Good	Good	Fair	Good	Very poor.	Very poor.	Good	Fair	Very poor.	Good.
Smokyhill-----	Good	Good	Good	Good	Good	Good	Fair	Fair	Good	Fair	Fair	Good.
Mu----- Muir	Good	Good	Good	Good	Good	Good	Poor	Very poor.	Good	Good	Very poor.	Good.
Oc. Orthents												
Pt*. Pits, quarries												
Ra, Re----- Reading	Good	Good	Good	Good	Good	Good	Poor	Poor	Good	Good	Poor	---
Sa, Sc----- Sarpy	Poor	Poor	Fair	Poor	Poor	---	Very poor.	Very poor.	Poor	Poor	Very poor.	---
Sh----- Solomon	Fair	Fair	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Good	---
St----- Sutphen	Fair	Fair	Fair	Fair	Fair	Fair	Poor	Good	Fair	Fair	Fair	---
Tn----- Tully	Good	Good	Good	---	---	Fair	Poor	Poor	Good	---	Poor	Fair.
To----- Tully	Fair	Good	Good	---	---	Fair	Poor	Poor	Fair	---	Poor	Fair.
Vc----- Valentine	Poor	Fair	Fair	Poor	Poor	Poor	Very poor.	Very poor.	Fair	Poor	Very poor.	Fair.
We*: Wells-----	Good	Good	Good	---	---	Fair	Very poor.	Very poor.	Good	---	Very poor.	Fair.
Ortello-----	Fair	Good	Good	Good	Good	Good	Very poor.	Very poor.	Good	Good	Very poor.	Good.
Wf*: Wells-----	Good	Good	Good	---	---	Fair	Very poor.	Very poor.	Good	---	Very poor.	Fair.

See footnote at end of table.

Table 10.--Wildlife Habitat--Continued

Soil name and map symbol	Potential for habitat elements								Potential as habitat for--			
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Hard- wood trees	Conif- erous plants	Shrubs	Wetland plants	Shallow water areas	Open- land wild- life	Wood- land wild- life	Wetland wild- life	Range- land wild- life
Wf*: Ortello-----	Fair	Good	Good	Good	Good	Good	Very poor.	Very poor.	Fair	Good	Very poor.	Good.

\* See description of the map unit for composition and behavior characteristics of the map unit.

Table 11.--Building Site Development

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Be*: Benfield-----	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.
Florence-----	Moderate: depth to rock, too clayey, large stones.	Moderate: shrink-swell, slope, large stones.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Severe: low strength.
Cc----- Clime	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
Cf*: Clime-----	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.
Sogn-----	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.
Cr, Cs, Ct----- Crete	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
Eu----- Eudora	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding, frost action.
Ge----- Geary	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.
Gf----- Geary	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength, frost action.
He----- Haynie	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding, frost action.
Hf, Hg----- Hobbs	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.
Hm----- Holder	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength, frost action.

See footnote at end of table.

Table 11.--Building Site Development--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Ho----- Holder	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength, frost action.
Id----- Irwin	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
Ka, Kb----- Kahola	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.
Ko----- Konza	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
Lm----- Ladysmith	Severe: wetness.	Severe: shrink-swell.	Severe: wetness, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Lo----- Longford	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Mb----- McCook	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Mc----- McCook	Slight-----	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding, frost action.
Mk*: McCook-----	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Smokyhill-----	Moderate: too clayey, flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.
Mu----- Muir	Slight-----	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: low strength, flooding, frost action.
Oc----- Orthents	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
Pt*. Pits, quarries					
Ra, Re----- Reading	Moderate: too clayey.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, frost action.
Sa, Sc----- Sarpy	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.

See footnote at end of table.

Table 11.--Building Site Development--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Sh----- Solomon	Severe: wetness.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: flooding, wetness, shrink-swell.	Severe: shrink-swell, low strength, wetness.
St----- Sutphen	Moderate: too clayey, flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, flooding, shrink-swell.
Tn, To----- Tully	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, low strength.
Vc----- Valentine	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
We*: Wells-----	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Ortello-----	Severe: cutbanks cave.	Slight-----	Slight-----	Slight-----	Moderate: frost action.
Wf*: Wells-----	Slight-----	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Ortello-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Moderate: frost action.

\* See description of the map unit for composition and behavior characteristics of the map unit.

Table 12.--Sanitary Facilities

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Be*:					
Benfield-----	Severe: thin layer, seepage, percs slowly.	Severe: seepage, slope.	Severe: seepage, slope, too clayey.	Severe: slope.	Poor: area reclaim, too clayey, hard to pack.
Florence-----	Severe: percs slowly.	Severe: slope.	Severe: depth to rock, seepage, too clayey.	Moderate: slope.	Poor: too clayey, hard to pack, small stones.
Cc-----	Severe: depth to rock, percs slowly, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: depth to rock, too clayey, hard to pack.
Cf*:					
Cline-----	Severe: thin layer, seepage, percs slowly.	Severe: seepage, slope.	Severe: seepage, too clayey.	Moderate: seepage, slope.	Poor: area reclaim, too clayey, hard to pack.
Sogn-----	Severe: thin layer, seepage.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage.	Severe: seepage.	Poor: area reclaim, thin layer.
Cr-----	Severe: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight-----	Poor: hard to pack.
Cs, Ct-----	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----	Poor: hard to pack.
Eu-----	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
Ge-----	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
Gf-----	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
He-----	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
Hf, Hg-----	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Poor: hard to pack.
Hm, Ho-----	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.

See footnote at end of table.

Table 12.--Sanitary Facilities--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Id----- Irwin	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----	Poor: too clayey, hard to pack.
Ka, Kb----- Kahola	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
Ko----- Konza	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----	Poor: too clayey, hard to pack.
Im----- Ladysmith	Severe: wetness, percs slowly.	Slight-----	Severe: too clayey.	Moderate: wetness.	Poor: too clayey, hard to pack.
Lo----- Longford	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----	Poor: too clayey, hard to pack.
Mb----- McCook	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
Mc----- McCook	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
Mk*: McCook-----	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
Smokyhill-----	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
Mu----- Muir	Moderate: flooding.	Moderate: seepage.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey.
Oc----- Orthents	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----	Poor: too clayey, hard to pack.
Pt*. Pits, quarries					
Ra, Re----- Reading	Severe: percs slowly.	Moderate: seepage.	Moderate: flooding, too clayey.	Moderate: flooding.	Fair: too clayey, thin layer.
Sa----- Sarpy	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, too sandy.	Severe: flooding, seepage.	Poor: seepage, too sandy.
Sc----- Sarpy	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, cemented pan, seepage.	Severe: flooding, seepage.	Poor: seepage, too sandy.

See footnote at end of table.

Table 12.--Sanitary Facilities--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Sh----- Solomon	Severe: flooding, wetness, percs slowly.	Severe: flooding.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, hard to pack, wetness.
St----- Sutphen	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, too clayey.	Severe: flooding.	Poor: too clayey, hard to pack.
Tn, To----- Tully	Severe: percs slowly.	Moderate: seepage, slope.	Severe: too clayey.	Slight-----	Poor: too clayey, hard to pack.
Vc----- Valentine	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
We*, WF*: Wells-----	Slight-----	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----	Fair: too clayey.
Ortello-----	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.

\* See description of the map unit for composition and behavior characteristics of the map unit.

Table 13.--Construction Materials

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Be*: Benfield-----	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, slope.
Florence-----	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
Cc----- Clime	Poor: depth to rock, low strength, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, slope.
Cf*: Clime-----	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, too clayey.
Sogn-----	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, thin layer.
Cr, Cs, Ct----- Crete	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Eu----- Eudora	Good-----	Improbable: excess fines.	Improbable: excess fines.	Good.
Ge----- Geary	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Gf----- Geary	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
He----- Haynie	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Hf, Hg----- Hobbs	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Hm, Ho----- Holder	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Id----- Irwin	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Ka, Kb----- Kahola	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.

See footnote at end of table.

Table 13.--Construction Materials--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ko----- Konza	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Im----- Ladysmith	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Lo----- Longford	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Mb, Mc----- McCook	Good-----	Improbable: excess fines.	Improbable: excess fines.	Good.
Mk*: McCook-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Good.
Smokyhill-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Mu----- Muir	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Oc----- Orthents	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Pt*. Pits, quarries				
Ra----- Reading	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Re----- Reading	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Sa, Sc----- Sarpy	Good-----	Probable-----	Improbable: too sandy.	Poor: too sandy.
Sh----- Solomon	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, too clayey.
St----- Sutphen	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Tn, To----- Tully	Poor: shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
Vc----- Valentine	Good-----	Probable-----	Improbable: too sandy.	Poor: area reclaim, too sandy.

See footnote at end of table.

Table 13.--Construction Materials--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
We*, WF*: Wells-----	Good-----	Improbable: excess fines.	Improbable: excess fines.	Good.
Ortello-----	Good-----	Probable-----	Improbable: too sandy.	Fair: thin layer.

\* See description of the map unit for composition and behavior characteristics of the map unit.

Table 14.--Water Management

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Be*:						
Benfield-----	Severe: slope.	Moderate: thin layer, hard to pack.	Deep to water	Percs slowly, thin layer, slope.	Slope, area reclaim, erodes easily.	Slope, erodes easily, area reclaim.
Florence-----	Severe: slope.	Severe: hard to pack.	Deep to water	Slope, large stones, droughty.	Slope, large stones.	Large stones, slope, droughty.
Cc-----	Severe: slope.	Moderate: thin layer, hard to pack.	Deep to water		Slope, depth to rock, percs slowly.	
Cf*:						
Clime-----	Severe: slope.	Moderate: thin layer, hard to pack.	Deep to water	Slope, percs slowly, thin layer.	Slope, area reclaim, erodes easily.	Slope, erodes easily, area reclaim.
Sogn-----	Severe: depth to rock, seepage, slope.	Severe: thin layer.	Deep to water	Slope, thin layer.	Slope, depth to rock, area reclaim.	Slope, depth to rock, area reclaim.
Cr, Cs-----	Moderate: seepage.	Moderate: piping, hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily	Erodes easily, percs slowly.
Ct-----	Moderate: seepage, slope.	Moderate: piping, hard to pack.	Deep to water	Slope, percs slowly, erodes easily.	Erodes easily	Erodes easily, percs slowly.
Bu-----	Moderate: seepage.	Severe: piping.	Deep to water	Flooding-----	Erodes easily	Erodes easily.
Ge-----	Moderate: seepage, slope.	Slight-----	Deep to water	Slope-----	Erodes easily	Erodes easily.
Gf-----	Severe: slope.	Slight-----	Deep to water	Slope-----	Slope, erodes easily.	Slope, erodes easily.
He-----	Moderate: seepage.	Severe: piping.	Deep to water	Favorable-----	Erodes easily	Erodes easily.
Hf, Hg-----	Moderate: seepage.	Severe: piping, hard to pack.	Deep to water	Flooding-----	Favorable-----	Favorable.
Hm-----	Moderate: seepage.	Severe: piping.	Deep to water	Favorable-----	Erodes easily	Erodes easily.
Ho-----	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope-----	Erodes easily	Erodes easily.

See footnote at end of table.

Table 14.--Water Management--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Id----- Irwin	Moderate: slope.	Severe: hard to pack.	Deep to water	Slope, percs slowly.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Ka, Kb----- Kahola	Moderate: seepage.	Moderate: piping.	Deep to water	Flooding-----	Favorable-----	Favorable.
Ko----- Konza	Slight-----	Severe: hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Lm----- Ladysmith	Slight-----	Severe: hard to pack.	Percs slowly---	Wetness, percs slowly, erodes easily.	Erodes easily, wetness, percs slowly.	Erodes easily, percs slowly.
Lo----- Longford	Slight-----	Moderate: hard to pack.	Deep to water	Percs slowly---	Percs slowly---	Percs slowly.
Mb----- McCook	Moderate: seepage.	Severe: piping.	Deep to water	Flooding-----	Erodes easily	Erodes easily.
Mc----- McCook	Moderate: seepage.	Severe: piping.	Deep to water	Favorable-----	Erodes easily	Erodes easily.
Mk*: McCook-----	Moderate: seepage.	Severe: piping.	Deep to water	Flooding-----	Erodes easily	Erodes easily.
Smokyhill-----	Moderate: seepage.	Severe: piping.	Deep to water	Percs slowly, flooding.	Erodes easily	Erodes easily, percs slowly.
Mu----- Muir	Moderate: seepage.	Severe: piping.	Deep to water	Favorable-----	Favorable-----	Favorable.
Oc----- Orthents	Moderate: slope.	Moderate: thin layer, hard to pack.	Deep to water	Slope, droughty, percs slowly.	Percs slowly---	Droughty, percs slowly.
Pt*. Pits, quarries						
Ra, Re----- Reading	Moderate: seepage.	Slight-----	Deep to water	Favorable-----	Erodes easily	Erodes easily.
Sa, Sc----- Sarpy	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake.	Too sandy, soil blowing.	Droughty.
Sh----- Solomon	Slight-----	Severe: hard to pack, wetness.	Percs slowly, flooding.	Wetness, droughty, slow intake.	Wetness, percs slowly.	Wetness, droughty, percs slowly.
St----- Sutphen	Slight-----	Moderate: hard to pack.	Deep to water	Slow intake, percs slowly, flooding.	Percs slowly---	Percs slowly.
Tn----- Tully	Slight-----	Moderate: hard to pack.	Deep to water	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
To----- Tully	Moderate: slope.	Moderate: hard to pack.	Deep to water	Slope, percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.

See footnote at end of table.

Table 14.--Water Management--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Vc----- Valentine	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Slope, droughty, fast intake.	Slope, too sandy, soil blowing.	Slope, droughty, rooting depth.
We*: Wells-----	Moderate: seepage.	Moderate: thin layer, piping.	Deep to water	Favorable-----	Favorable-----	Favorable.
Ortello-----	Severe: seepage.	Severe: seepage, piping.	Deep to water	Soil blowing---	Too sandy, soil blowing.	Favorable.
Wf*: Wells-----	Moderate: seepage, slope.	Moderate: thin layer, piping.	Deep to water	Slope-----	Favorable-----	Favorable.
Ortello-----	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, soil blowing.	Too sandy, soil blowing.	Favorable.

\* See description of the map unit for composition and behavior characteristics of the map unit.

Table 15.--Engineering Index Properties

(The symbol &lt; means less than; &gt; means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO							
						4	10	40	200		
	In				Pct					Pct	
Be*:											
Benfield-----	0-5	Silty clay loam	CL	A-6, A-7	0-15	85-100	85-100	85-100	75-95	35-45	15-20
	5-10	Silty clay, silty clay loam, clay.	CH, CL	A-7-6	0-15	60-100	55-100	50-100	50-95	45-60	20-30
	10-38	Silty clay loam, clay, silty clay.	CH, CL	A-7-6	0-5	60-100	55-100	50-100	50-95	45-60	20-30
	38	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Florence-----	0-5	Gravelly silt loam.	GC, SC, CL	A-7, A-2-7, A-7-6	0-10	30-90	20-75	20-75	20-70	40-50	20-30
	5-14	Very gravelly silty clay loam, very gravelly silty clay.	GC, SC	A-2-7, A-7	10-20	30-70	20-50	20-50	15-40	50-70	30-45
	14-56	Extremely cobbly clay, gravelly clay, very gravelly clay.	GC, SC, CH	A-2-7, A-7	10-40	30-90	20-75	20-75	15-70	65-75	40-50
	56	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Cc----- Cline	0-2	Stony silty clay loam.	CL	A-7-6	1-5	85-100	80-100	75-100	70-95	40-50	20-25
	2-9	Silty clay loam, silty clay.	CL, CH	A-7-6	0-3	95-100	95-100	95-100	85-95	40-60	20-35
	9-27	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	95-100	95-100	95-100	85-95	45-65	20-40
	27-33	Silty clay, clay, silty clay loam.	CL, CH	A-7	0	95-100	95-100	95-100	85-95	45-60	20-30
	33	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Cf*:											
Cline-----	0-12	Silty clay loam	CL	A-7-6	0-5	90-100	90-100	85-100	80-95	40-50	20-25
	12-26	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	95-100	95-100	95-100	85-95	45-65	20-40
	26-30	Silty clay, clay, silty clay loam.	CL, CH	A-7	0	95-100	95-100	95-100	85-95	45-60	20-30
	30	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Sogn-----	0-9	Silty clay loam	CL	A-6, A-7	0-10	85-100	85-100	85-100	70-100	35-45	15-20
	9	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Cr, Cs----- Crete	0-6	Silty clay loam	CL	A-6, A-7	0	100	100	100	90-100	35-50	15-30
	6-11	Silty clay loam	CL	A-6, A-7	0	100	100	100	90-100	35-50	15-30
	11-40	Silty clay, silty clay loam.	CH	A-7	0	100	100	100	90-100	50-65	25-40
	40-70	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	100	95-100	30-55	10-35

See footnote at end of table.

Table 15.--Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO							
						4	10	40	200		
	In				Pct					Pct	
Ct----- Crete	0-4	Silty clay loam	CL	A-6, A-7	0	100	100	100	90-100	35-50	15-30
	4-8	Silty clay loam	CL	A-6, A-7	0	100	100	100	90-100	35-50	15-30
	8-42	Silty clay, silty clay loam.	CH	A-7	0	100	100	100	90-100	50-65	25-40
	42-60	Silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	100	95-100	30-55	10-35
Eu----- Eudora	0-19	Silt loam-----	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	60-100	20-30	2-11
	19-60	Silt loam, very fine sandy loam, loam.	ML, CL, CL-ML	A-4	0	100	100	95-100	65-100	<25	NP-10
Ge----- Geary	0-18	Silt loam-----	CL	A-4, A-6	0	100	100	90-100	80-100	25-35	10-15
	18-48	Silty clay loam, clay loam.	CL	A-7, A-6	0	100	100	90-100	70-95	25-45	15-20
	48-60	Silty clay loam, clay loam, silt loam.	CL	A-6, A-7	0	100	100	90-100	70-100	25-45	10-20
Gf----- Geary	0-12	Silt loam-----	CL	A-4, A-6	0	100	100	90-100	80-100	25-35	10-15
	12-42	Silty clay loam, clay loam.	CL	A-7, A-6	0	100	100	90-100	70-95	25-45	15-20
	42-60	Silty clay loam, clay loam, silt loam.	CL	A-6, A-7	0	100	100	90-100	70-100	25-45	10-20
He----- Haynie	0-10	Silt loam-----	CL-ML, CL	A-4, A-6	0	100	100	85-100	70-100	25-40	5-15
	10-60	Silt loam, very fine sandy loam.	CL-ML, CL	A-4, A-6	0	100	100	85-100	85-100	25-35	5-15
Hf, Hg----- Hobbs	0-8	Silt loam-----	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-20
	8-24	Stratified silt loam.	CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	25-40	5-20
	24-60	Silt loam, silty clay loam, very fine sandy loam.	CL, CL-ML, MH	A-4, A-6, A-7	0	100	100	95-100	80-100	25-55	5-25
Hm----- Holder	0-12	Silt loam-----	ML, CL, CL-ML	A-4, A-6	0	100	100	98-100	90-100	20-40	2-16
	12-49	Silty clay loam	CL	A-6, A-7	0	100	100	98-100	95-100	35-50	20-35
	49-60	Silt loam, silty clay loam.	CL, ML	A-4, A-6, A-7	0	100	100	95-100	90-100	30-45	5-20
Ho----- Holder	0-14	Silt loam-----	ML, CL, CL-ML	A-4, A-6	0	100	100	98-100	90-100	20-40	2-16
	14-45	Silty clay loam	CL	A-6, A-7	0	100	100	98-100	95-100	35-50	20-35
	45-60	Silt loam, silty clay loam.	CL, ML	A-4, A-6, A-7	0	100	100	95-100	90-100	30-45	5-20
Id----- Irwin	0-13	Silty clay loam	CL	A-6, A-7-6	0	100	95-100	90-100	80-95	35-45	15-20
	13-41	Silty clay, clay	CH	A-7-6	0	100	95-100	95-100	85-95	50-60	25-30
	41-72	Silty clay, clay, silty clay loam.	CH, CL	A-7-6	0	100	100	95-100	80-95	40-60	20-30
Ka----- Kahola	0-5	Silt loam-----	CL	A-4, A-6	0	100	95-100	90-100	70-90	30-35	10-15
	5-60	Silt loam, loam, silty clay loam.	CL	A-4, A-6, A-7	0	100	95-100	90-100	75-95	30-45	10-20

See footnote at end of table.

Table 15.--Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit Pct	Plas- ticity index
			Unified	AASHTO							
						4	10	40	200		
	In				Pct					Pct	
Kb----- Kahola	0-6	Silt loam-----	CL	A-4, A-6	0	100	95-100	90-100	70-90	30-35	10-15
	6-44	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	95-100	90-100	80-95	30-45	10-20
	44-60	Silt loam, loam, silty clay loam.	CL	A-4, A-6, A-7	0	100	95-100	90-100	75-95	30-45	10-20
Ko----- Konza	0-6	Silty clay loam	CL	A-7	0	100	100	95-100	85-95	45-50	25-30
	6-34	Silty clay, clay	CH	A-7	0	100	100	90-100	80-95	55-70	35-45
	34-50	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	95-100	85-95	45-70	25-40
	50-80	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	85-100	80-95	50-70	30-45
Lm----- Ladysmith	0-7	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-95	30-45	15-25
	7-30	Silty clay, clay	CH	A-7-6	0	100	100	95-100	85-95	50-70	30-50
	30-60	Silty clay, silty clay loam, clay.	CL, CH	A-7-6	0	100	100	95-100	85-95	40-65	25-45
Lo----- Longford	0-11	Loam-----	CL	A-6, A-7	0	100	95-100	85-95	65-75	30-45	15-25
	11-46	Silty clay loam, silty clay, clay loam.	CH	A-7-6	0	100	95-100	90-100	75-95	50-60	30-40
	46-60	Clay loam, silty clay loam, loam.	CL	A-6, A-7-6	0	100	95-100	85-100	70-95	35-50	15-30
Mb----- McCook	0-16	Silt loam-----	ML, CL, CL-ML	A-4	0	100	100	95-100	60-100	20-35	2-10
	16-60	Very fine sandy loam, silt loam, loam.	ML, CL, CL-ML	A-4	0	100	100	95-100	80-100	<20	NP-10
Mc----- McCook	0-19	Silt loam-----	ML, CL, CL-ML	A-4	0	100	100	95-100	60-100	20-35	2-10
	19-60	Very fine sandy loam, silt loam, loam.	ML, CL, CL-ML	A-4	0	100	100	95-100	80-100	<20	NP-10
Mk*: McCook-----	0-12	Silt loam-----	ML, CL, CL-ML	A-4	0	100	100	95-100	60-100	20-35	2-10
	12-60	Very fine sandy loam, silt loam, loam.	ML, CL, CL-ML	A-4	0	100	100	95-100	80-100	<20	NP-10
Smokyhill-----	0-6	Silt loam-----	CL	A-4, A-6	0	100	100	90-100	70-90	30-35	10-15
	6-14	Silty clay loam	ML	A-7	0	100	100	95-100	85-95	45-50	15-20
	14-30	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	95-100	85-95	45-55	20-30
	30-72	Silt loam, very fine sandy loam.	ML, CL, CL-ML	A-4	0	100	100	85-100	50-90	20-30	NP-10
Mu----- Muir	0-16	Silt loam-----	CL	A-6	0	100	100	90-100	70-90	30-35	10-15
	16-44	Silt loam, silty clay loam, loam.	CL	A-6, A-7-6	0	100	100	85-100	65-90	30-45	10-20
	44-60	Silt loam, silty clay loam, loam.	CL	A-6, A-7-6	0	100	100	85-100	65-90	30-45	10-20
Oc----- Orthents	0-4	Silty clay-----	CH, CL	A-7	0	100	100	95-100	90-100	35-55	15-30
	4-20	Clay loam, silty clay loam, silty clay.	CH, CL	A-6, A-7	0	100	95-100	95-100	80-100	35-60	15-40

See footnote at end of table.

Table 15.--Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit Pct	Plas- ticity index
			Unified	AASHTO							
						4	10	40	200		
	In				Pct						
Pt*. Pits, quarries											
Ra-----	0-8	Silt loam-----	CL	A-6	0	100	100	90-100	80-90	30-35	10-15
Reading	8-20	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-95	35-45	15-20
	20-60	Silty clay loam, clay loam, silty clay.	CL	A-7	0	100	100	95-100	80-95	40-50	20-30
Re-----	0-20	Silty clay loam	CL	A-6	0	100	100	95-100	85-100	35-40	15-20
Reading	20-52	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-95	35-45	15-20
	52-60	Silty clay loam, clay loam, silty clay.	CL	A-7	0	100	100	95-100	80-95	40-50	20-30
Sa-----	0-9	Loamy fine sand	SM	A-2-4	0	100	100	60-80	15-35	---	NP
Sarpy	9-60	Fine sand, loamy fine sand, sand.	SM, SP, SP-SM	A-2-4, A-3	0	100	100	60-80	2-35	---	NP
Sc-----	0-14	Gravelly loamy sand.	SM	A-2-4	15-35	60-80	50-75	25-55	8-20	---	NP
Sarpy	14-60	Fine sand, loamy fine sand, sand.	SM, SP, SP-SM	A-2-4, A-3	0	100	100	60-80	2-35	---	NP
Sh-----	0-19	Silty clay-----	CH	A-7	0	100	100	90-100	75-95	55-70	35-45
Solomon	19-60	Silty clay, clay	CH	A-7	0	100	100	90-100	75-95	55-70	35-45
St-----	0-21	Silty clay-----	CH	A-7	0	100	100	95-100	90-95	55-70	35-45
Sutphen	21-30	Clay, silty clay	CH	A-7	0	100	100	95-100	90-100	55-70	35-45
	30-60	Clay, silty clay, silty clay loam.	CH	A-7	0	100	100	95-100	90-100	50-70	30-45
Tn-----	0-7	Silty clay loam	CL	A-6, A-7	0	100	95-100	90-100	80-95	35-45	15-20
Tully	7-13	Silty clay loam	CL	A-6, A-7	0	100	95-100	90-100	80-95	35-45	15-20
	13-60	Silty clay, clay	CH	A-7	0	90-100	80-100	75-100	65-95	55-65	30-40
To-----	0-12	Silty clay loam	CL	A-6, A-7	0	100	95-100	90-100	80-95	35-45	15-20
Tully	12-21	Silty clay loam	CL	A-6, A-7	0	100	95-100	90-100	80-95	35-45	15-20
	21-40	Silty clay, clay	CH	A-7	0	90-100	80-100	75-100	65-95	55-65	30-40
	40-60	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	90-100	80-100	75-100	65-100	45-65	20-40
Vc-----	0-5	Loamy fine sand	SM, SP-SM, SP	A-2, A-3	0	100	100	95-100	2-35	---	NP
Valentine	5-50	Loamy fine sand, loamy sand.	SM, SP-SM, SP	A-2, A-3	0	100	100	90-100	2-35	---	NP
	50-60	Fine sand, sand	SM, SP-SM, SP	A-2, A-3	0	100	100	70-100	2-25	---	NP
We*: Wells-----	0-11	Loam-----	CL	A-4, A-6	0	100	100	85-95	60-75	30-35	10-15
	11-38	Clay loam, sandy clay loam.	SC, CL, SM, ML	A-4, A-6, A-7	0	100	100	85-100	40-80	35-45	10-20
	38-60	Clay loam, sandy clay loam, sandy loam.	SC, CL, ML, SM	A-4, A-6	0	100	100	70-100	35-80	20-40	5-20

See footnote at end of table.

Table 15.--Engineering Index Properties--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments 3-10 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO							
						4	10	40	200		
	<u>In</u>				<u>Pct</u>					<u>Pct</u>	
We*:											
Ortello-----	0-15	Sandy loam-----	SM, ML	A-4	0	100	100	70-95	40-55	<20	NP
	15-60	Fine sandy loam, sandy loam.	SM, ML	A-4	0	100	100	70-95	40-55	<20	NP
Wf*:											
Wells-----	0-12	Loam-----	CL	A-4, A-6	0	100	100	85-95	60-75	30-35	10-15
	12-37	Clay loam, sandy clay loam.	SC, CL, SM, ML	A-4, A-6, A-7	0	100	100	85-100	40-80	35-45	10-20
	37-63	Clay loam, sandy clay loam, sandy loam.	SC, CL, ML, SM	A-4, A-6	0	100	100	70-100	35-80	20-40	5-20
Ortello-----	0-6	Sandy loam-----	SM, ML	A-4	0	100	100	70-95	40-55	<20	NP
	6-46	Fine sandy loam, sandy loam.	SM, ML	A-4	0	100	100	70-95	40-55	<20	NP
	46-60	Fine sand, loamy fine sand, loamy sand.	SP-SM, SM	A-3, A-2	0	100	100	50-70	5-35	---	NP

\* See description of the map unit for composition and behavior characteristics of the map unit.

Table 16.--Physical and Chemical Properties of the Soils

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors	Wind erodi- bility	Organic matter	
	In	Pct	G/cc	In/hr	In/in	pH	mmhos/cm		K	T	Pct	
Be*:												
Benfield-----	0-5	27-35	1.30-1.40	0.2-0.6	0.21-0.24	6.1-7.8	<2	Moderate	0.37	3	7	2-6
	5-10	35-50	1.35-1.45	0.06-0.2	0.11-0.20	6.6-8.4	<2	High-----	0.37			
	10-38	35-50	1.35-1.45	0.06-0.2	0.11-0.20	7.4-8.4	<2	High-----	0.37			
	38	---	---	0.06-0.2	---	---	<2	-----	---			
Florence-----	0-5	24-35	1.25-1.35	0.6-2.0	0.05-0.20	5.6-7.3	<2	Moderate	0.24	3	8	2-4
	5-14	35-55	1.35-1.55	0.2-0.6	0.03-0.11	5.6-7.3	<2	Moderate	0.24			
	14-56	50-80	1.35-1.55	0.2-0.6	0.03-0.12	6.1-7.8	<2	High-----	0.24			
	56	---	---	0.06-0.2	---	---	<2	-----	---			
Cc-----	0-2	32-40	1.35-1.45	0.2-0.6	0.21-0.23	6.6-8.4	<2	Moderate	0.28	3	8	2-4
Clime	2-9	32-50	1.35-1.45	0.06-0.6	0.12-0.23	6.6-8.4	<2	Moderate	0.28			
	9-27	35-60	1.35-1.50	0.06-0.2	0.09-0.20	7.4-8.4	<2	Moderate	0.28			
	27-33	35-50	1.40-1.50	0.06-0.2	0.08-0.20	7.4-8.4	<2	Moderate	0.28			
	33	---	---	0.01-0.06	---	---	<2	-----	---			
Cf*:												
Clime-----	0-12	32-40	1.35-1.45	0.2-0.6	0.21-0.23	6.6-8.4	<2	Moderate	0.32	3	7	2-4
	12-26	35-60	1.35-1.50	0.06-0.2	0.12-0.18	7.4-8.4	<2	Moderate	0.28			
	26-30	35-50	1.40-1.50	0.06-0.2	0.10-0.14	7.4-8.4	<2	Moderate	0.32			
	30	---	---	0.01-0.06	---	---	<2	-----	---			
Sogn-----	0-9	27-35	1.35-1.45	0.6-2.0	0.21-0.23	6.1-8.4	<2	Moderate	0.32	1	4L	1-3
	9	---	---	0.06-0.6	---	---	<2	-----	---			
Cr, Cs-----	0-6	27-35	1.20-1.40	0.2-0.6	0.21-0.23	5.6-6.0	<2	High-----	0.37	4	7	2-4
Crete	6-11	27-35	1.20-1.40	0.2-0.6	0.21-0.23	5.6-6.0	<2	High-----	0.37			
	11-40	35-55	1.10-1.30	0.06-0.2	0.12-0.20	6.1-7.3	<2	High-----	0.37			
	40-70	25-40	1.20-1.40	0.2-2.0	0.18-0.22	7.4-8.4	<2	High-----	0.37			
Ct-----	0-4	27-35	1.20-1.40	0.2-0.6	0.21-0.23	5.6-6.0	<2	High-----	0.37	4	7	2-4
Crete	4-8	27-35	1.20-1.40	0.2-0.6	0.21-0.23	5.6-6.0	<2	High-----	0.37			
	8-42	35-55	1.10-1.30	0.06-0.2	0.12-0.20	6.1-7.3	<2	High-----	0.37			
	42-60	25-40	1.20-1.40	0.2-2.0	0.18-0.22	7.4-8.4	<2	High-----	0.37			
Bu-----	0-19	5-18	1.30-1.50	0.6-2.0	0.20-0.24	6.1-7.8	<2	Low-----	0.32	5	5	1-3
Eudora	19-60	5-18	1.35-1.50	0.6-2.0	0.17-0.22	6.6-8.4	<2	Low-----	0.43			
Ge-----	0-18	15-27	1.35-1.40	0.6-2.0	0.22-0.24	5.6-6.5	<2	Low-----	0.32	5	6	1-4
Geary	18-48	27-35	1.35-1.40	0.6-2.0	0.15-0.20	6.1-7.8	<2	Moderate	0.43			
	48-60	15-35	1.35-1.40	0.6-2.0	0.14-0.20	6.1-8.4	<2	Moderate	0.43			
Gf-----	0-12	15-27	1.35-1.40	0.6-2.0	0.22-0.24	5.6-6.5	<2	Low-----	0.32	5	6	1-4
Geary	12-42	27-35	1.35-1.40	0.6-2.0	0.15-0.20	6.1-7.8	<2	Moderate	0.43			
	42-60	15-35	1.35-1.40	0.6-2.0	0.14-0.20	6.1-8.4	<2	Moderate	0.43			
He-----	0-10	15-25	1.20-1.35	0.6-2.0	0.18-0.23	6.6-8.4	<2	Low-----	0.32	5	4L	1-3
Haynie	10-60	15-18	1.20-1.35	0.6-2.0	0.18-0.23	7.4-8.4	<2	Low-----	0.43			
Hf, Hg-----	0-8	15-27	1.20-1.40	0.6-2.0	0.21-0.24	6.1-7.8	<2	Low-----	0.32	5	6	2-4
Hobbs	8-24	15-27	1.20-1.40	0.6-2.0	0.18-0.20	6.1-7.8	<2	Low-----	0.32			
	24-60	15-30	1.20-1.40	0.6-2.0	0.18-0.22	6.6-8.4	<2	-----	---			

See footnote at end of table.

Table 16.--Physical and Chemical Properties of the Soils--Continued

Soil name and map symbol	Depth		Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors		Wind erodi- bility	Organic matter
	In	Pct	G/cc	In/hr	In/in	pH	mmhos/cm			K	T	group	Pct
Hm----- Holder	0-12	15-27	1.40-1.60	0.6-2.0	0.22-0.24	5.1-7.3	<2	Low-----	0.32	5			1-3
	12-49	28-35	1.20-1.40	0.6-2.0	0.18-0.20	6.1-7.8	<2	Moderate	0.43			6	
	49-60	15-30	1.40-1.60	0.6-2.0	0.20-0.22	6.6-8.4	<2	Moderate	0.43				
Ho----- Holder	0-14	15-27	1.40-1.60	0.6-2.0	0.22-0.24	5.1-7.3	<2	Low-----	0.32	5		6	1-3
	14-45	28-35	1.20-1.40	0.6-2.0	0.18-0.20	6.1-7.8	<2	Moderate	0.43				
	45-60	15-30	1.40-1.60	0.6-2.0	0.20-0.22	6.6-8.4	<2	Moderate	0.43				
Id----- Irwin	0-13	28-35	1.35-1.45	0.2-0.6	0.21-0.23	5.6-7.3	<2	Moderate	0.32	3		7	2-4
	13-41	40-60	1.40-1.50	<0.06	0.10-0.13	5.6-8.4	2-4	High-----	0.28				
	41-72	35-55	1.40-1.50	<0.2	0.09-0.19	6.6-8.4	2-4	High-----	0.32				
Ka----- Kahola	0-5	18-27	1.35-1.40	0.6-2.0	0.21-0.24	6.1-7.8	<2	Moderate	0.32	5		6	2-4
	5-60	18-35	1.35-1.40	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.43				
Kb----- Kahola	0-6	18-27	1.35-1.40	0.6-2.0	0.21-0.24	6.1-7.8	<2	Moderate	0.32	5		6	2-4
	6-44	18-35	1.35-1.40	0.6-2.0	0.18-0.27	7.4-8.4	<2	Moderate	0.43				
	44-60	18-35	1.35-1.40	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.43				
Ko----- Konza	0-6	27-35	1.20-1.35	0.2-0.6	0.21-0.23	6.1-7.3	<2	Moderate	0.37	3		7	2-6
	6-34	40-55	1.30-1.40	<0.06	0.09-0.13	6.1-8.4	<2	High-----	0.37				
	34-50	30-45	1.40-1.50	0.06-0.2	0.10-0.20	6.6-8.4	2-4	High-----	0.37				
	50-80	35-55	1.40-1.50	<0.06	0.10-0.20	6.6-8.4	2-8	High-----	0.37				
Lm----- Ladysmith	0-7	28-35	1.35-1.45	0.2-0.6	0.21-0.23	5.6-7.3	<2	Moderate	0.37	4		7	2-4
	7-30	40-60	1.35-1.50	<0.06	0.10-0.15	5.6-7.8	<2	High-----	0.37				
	30-60	35-55	1.40-1.60	0.06-0.6	0.10-0.19	7.4-8.4	<2	Moderate	0.37				
Lo----- Longford	0-11	15-27	1.30-1.40	0.6-2.0	0.20-0.22	5.6-7.3	<2	Low-----	0.28	5		6	1-4
	11-46	35-45	1.35-1.50	0.06-0.2	0.14-0.20	5.1-7.3	<2	High-----	0.32				
	46-60	20-35	1.30-1.40	0.2-0.6	0.15-0.20	6.1-7.8	<2	Moderate	0.32				
Mb----- McCook	0-16	15-20	1.20-1.40	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low-----	0.32	5		4L	2-4
	16-60	10-18	1.30-1.45	0.6-2.0	0.17-0.20	7.4-8.4	<2	Low-----	0.43				
Mc----- McCook	0-19	15-20	1.20-1.40	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low-----	0.32	5		4L	2-4
	19-60	10-18	1.30-1.45	0.6-2.0	0.17-0.20	7.4-8.4	<2	Low-----	0.43				
Mk*:													
McCook-----	0-12	15-20	1.20-1.40	0.6-2.0	0.20-0.24	7.4-8.4	<2	Low-----	0.32	5		4L	2-4
	12-60	10-18	1.30-1.45	0.6-2.0	0.17-0.20	7.4-8.4	<2	Low-----	0.43				
Smokyhill-----	0-6	18-27	1.20-1.30	0.6-2.0	0.22-0.24	6.6-7.8	<2	Low-----	0.32	5		4L	2-4
	6-14	35-40	1.20-1.30	0.2-0.6	0.21-0.23	6.6-7.8	<2	Moderate	0.32				
	14-30	35-45	1.20-1.30	0.06-0.2	0.11-0.20	7.4-8.4	<2	Moderate	0.28				
	30-72	10-18	1.30-1.40	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low-----	0.43				
Mu----- Muir	0-16	18-27	1.30-1.45	0.6-2.0	0.22-0.24	5.6-7.3	<2	Low-----	0.32	5		6	2-4
	16-44	18-35	1.30-1.50	0.6-2.0	0.18-0.22	6.1-7.3	<2	Low-----	0.32				
	44-60	18-35	1.30-1.50	0.6-2.0	0.18-0.22	6.1-8.4	<2	Low-----	0.32				
Oc----- Orthents	0-4	27-50	1.35-1.45	0.06-0.6	0.09-0.12	5.6-7.8	<2	High-----	0.37	3		4	<1
	4-20	35-50	1.35-1.50	0.06-0.2	0.10-0.14	5.6-7.8	<2	High-----	0.32				
Pt*. Pits, quarries													
Ra----- Reading	0-8	18-27	1.35-1.40	0.6-2.0	0.22-0.24	5.6-6.5	<2	Low-----	0.32	5		6	2-4
	8-20	27-35	1.40-1.50	0.2-2.0	0.18-0.20	5.6-6.5	<2	Moderate	0.43				
	20-60	30-42	1.40-1.50	0.2-2.0	0.13-0.20	6.1-8.4	<2	Moderate	0.43				

See footnote at end of table.

Table 16.--Physical and Chemical Properties of the Soils--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors		Wind erodi- bility	Organic matter
	In	Pct	G/cc	In/hr	In/in	pH	mmhos/cm		K	T	group	Pct
Re----- Reading	0-20	27-30	1.35-1.40	0.6-2.0	0.21-0.23	5.6-6.5	<2	Moderate	0.32	5	7	2-4
	20-52	27-35	1.40-1.50	0.2-2.0	0.18-0.20	5.6-6.5	<2	Moderate	0.43			
	52-60	30-42	1.40-1.50	0.2-2.0	0.13-0.20	6.1-8.4	<2	Moderate	0.43			
Sa----- Sarpy	0-9	2-5	1.20-1.50	>6.0	0.05-0.09	6.6-8.4	<2	Low-----	0.17	5	2	<1
	9-60	2-5	1.20-1.50	>6.0	0.05-0.09	6.6-8.4	<2	Low-----	0.15			
Sc----- Sarpy	0-14	2-5	1.20-1.50	>6.0	0.10-0.12	6.6-8.4	<2	Low-----	0.17	5	2	<1
	14-60	2-5	1.20-1.50	>6.0	0.05-0.09	7.4-8.4	<2	Low-----	0.15			
Sh----- Solomon	0-19	40-55	1.35-1.45	<0.06	0.12-0.14	7.4-8.4	<2	High-----	0.28	5	4L	2-4
	19-60	40-55	1.35-1.45	<0.06	0.08-0.12	7.9-9.0	<2	High-----	0.28			
St----- Sutphen	0-21	40-55	1.35-1.45	<0.06	0.12-0.14	6.1-8.4	<2	High-----	0.28	5	4	2-4
	21-30	40-55	1.35-1.45	<0.06	0.10-0.14	6.6-8.4	<2	High-----	0.28			
	30-60	35-55	1.35-1.45	<0.2	0.10-0.18	7.4-8.4	<2	High-----	0.28			
Tn----- Tully	0-7	28-38	1.35-1.45	0.2-2.0	0.21-0.23	5.6-7.3	---	Moderate	0.37	4	7	3-6
	7-13	27-40	1.35-1.45	0.2-2.0	0.18-0.20	5.6-7.3	---	Moderate	0.37			
	13-60	40-55	1.40-1.50	0.06-0.2	0.10-0.15	5.6-8.4	---	High-----	0.32			
To----- Tully	0-12	28-38	1.35-1.45	0.2-2.0	0.21-0.23	5.6-7.3	---	Moderate	0.37	4	7	3-6
	12-21	27-40	1.35-1.45	0.2-2.0	0.18-0.20	5.6-7.3	---	Moderate	0.37			
	21-40	40-55	1.40-1.50	0.06-0.2	0.10-0.15	5.6-8.4	---	High-----	0.32			
	40-60	35-55	1.40-1.50	0.06-0.2	0.07-0.12	6.6-8.4	---	High-----	0.32			
Vc----- Valentine	0-5	2-10	1.70-1.90	6.0-20	0.10-0.12	5.6-7.3	<2	Low-----	0.17	5	2	.5-1
	5-50	2-10	1.70-1.90	6.0-20	0.09-0.11	5.6-7.3	<2	Low-----	0.17			
	50-60	0-6	1.70-1.90	6.0-20	0.05-0.07	5.6-7.3	<2	Low-----	0.15			
We*:												
Wells-----	0-11	18-27	1.35-1.50	0.6-2.0	0.20-0.22	5.6-6.5	<2	Low-----	0.28	5	6	1-4
	11-38	27-35	1.35-1.60	0.6-2.0	0.15-0.19	5.6-7.3	<2	Moderate	0.32			
	38-60	10-30	1.35-1.50	0.6-2.0	0.15-0.19	5.6-7.3	<2	Low-----	0.32			
Ortello-----	0-15	5-15	1.40-1.60	2.0-6.0	0.13-0.18	5.6-7.3	<2	Low-----	0.20	5	3	1-2
	15-60	5-15	1.40-1.60	2.0-6.0	0.12-0.17	6.1-7.3	<2	Low-----	0.20			
Wf*:												
Wells-----	0-12	18-27	1.35-1.50	0.6-2.0	0.20-0.22	5.6-6.5	<2	Low-----	0.28	5	6	1-4
	12-37	27-35	1.35-1.60	0.6-2.0	0.15-0.19	5.6-7.3	<2	Moderate	0.32			
	37-63	10-30	1.35-1.50	0.6-2.0	0.15-0.19	5.6-7.3	<2	Low-----	0.32			
Ortello-----	0-6	5-15	1.40-1.60	2.0-6.0	0.13-0.18	5.6-7.3	<2	Low-----	0.20	5	3	1-2
	6-46	5-15	1.40-1.60	2.0-6.0	0.12-0.17	6.1-7.3	<2	Low-----	0.20			
	46-60	2-10	1.50-1.70	6.0-20	0.05-0.10	6.6-7.8	<2	Low-----	0.15			

\* See description of the map unit for composition and behavior characteristics of the map unit.

Table 17.--Soil and Water Features

("Flooding," "water table," and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					<u>Ft</u>			<u>In</u>				
Be*:												
Benfield-----	C	None-----	---	---	>6.0	---	---	20-40	Soft	Moderate	High-----	Low.
Florence-----	C	None-----	---	---	>6.0	---	---	40-60	Hard	Moderate	Moderate	Low.
Cc-----	C	None-----	---	---	>6.0	---	---	20-40	Soft	Moderate	High-----	Low.
Cline												
Cf*:												
Cline-----	C	None-----	---	---	>6.0	---	---	20-40	Soft	Moderate	High-----	Low.
Sogn-----	D	None-----	---	---	>6.0	---	---	4-20	Hard	Moderate	Low-----	Low.
Cr, Cs, Ct-----	C	None-----	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Crete												
Eu-----	B	Occasional	Very brief	Apr-Oct	>6.0	---	---	>60	---	High-----	Low-----	Low.
Eudora												
Ge, Gf-----	B	None-----	---	---	>6.0	---	---	>60	---	High-----	Low-----	Low.
Geary												
He-----	B	Frequent----	Very brief	Apr-Oct	>6.0	---	---	>60	---	High-----	Low-----	Low.
Haynie												
Hf-----	B	Frequent----	Brief-----	Apr-Oct	>6.0	---	---	>60	---	Moderate	Low-----	Low.
Hobbs												
Hg-----	B	Occasional	Brief-----	Apr-Oct	>6.0	---	---	>60	---	Moderate	Low-----	Low.
Hobbs												
Hm, Ho-----	B	None-----	---	---	>6.0	---	---	>60	---	High-----	Low-----	Low.
Holder												
Id-----	D	None-----	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
Irwin												
Ka-----	B	Frequent----	Very brief	Apr-Oct	>6.0	---	---	>60	---	Moderate	Low-----	Low.
Kahola												
Kb-----	B	Occasional	Very brief	Apr-Oct	>6.0	---	---	>60	---	Moderate	Low-----	Low.
Kahola												
Ko-----	D	None-----	---	---	>6.0	---	---	>60	---	Moderate	High-----	Moderate.
Konza												
Lm-----	D	None-----	---	---	2.0-3.0	Perched	Apr-Jun	>60	---	Moderate	High-----	Low.
Ladysmith												
Lo-----	C	None-----	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
Longford												
Mb-----	B	Occasional	Very brief	Apr-Oct	>6.0	---	---	>60	---	Moderate	Low-----	Low.
McCook												

See footnote at end of table.

Table 17.--Soil and Water Features--Continued

Soil name and map symbol	Hydro- logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					<u>Ft</u>			<u>In</u>				
Mc----- McCook	B	Rare-----	---	---	>6.0	---	---	>60	---	Moderate	Low-----	Low.
Mk*: McCook-----	B	Occasional	Very brief	Apr-Oct	>6.0	---	---	>60	---	Moderate	Low-----	Low.
Smokyhill-----	C	Occasional	Brief-----	Apr-Oct	>6.0	---	---	>60	---	Low-----	High-----	Low.
Mu----- Muir	B	Rare-----	---	---	>6.0	---	---	>60	---	Moderate	Low-----	Moderate.
Oc----- Orthents	D	None-----	---	---	>6.0	---	---	>60	---	Low-----	High-----	Moderate.
Pt*. Pits, quarries												
Ra, Re----- Reading	B	Rare-----	---	---	>6.0	---	---	>60	---	High-----	Moderate	Low.
Sa----- Sarpy	A	Occasional	Brief-----	Apr-Oct	>6.0	---	---	>60	---	Low-----	Low-----	Low.
Sc----- Sarpy	A	Occasional	Brief-----	Apr-Oct	>6.0	---	---	>60	---	Low-----	Low-----	Low.
Sh----- Solomon	D	Occasional	Brief to long.	Nov-May	0-2.0	Apparent	Dec-May	>60	---	Moderate	High-----	Low.
St----- Sutphen	D	Occasional	Very brief	Apr-Oct	>6.0	---	---	>60	---	Low-----	High-----	Low.
Tn, To----- Tully	C	None-----	---	---	>6.0	---	---	>60	---	Low-----	High-----	Low.
Vc----- Valentine	A	None-----	---	---	>6.0	---	---	>60	---	Low-----	Low-----	Low.
We*, Wf*: Wells-----	B	None-----	---	---	>6.0	---	---	>60	---	Moderate	Low-----	Moderate.
Ortello-----	B	None-----	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.

\* See description of the map unit for composition and behavior characteristics of the map unit.

Table 18.--Classification of the Soils

Soil name	Family or higher taxonomic class
Benfield-----	Fine, mixed, mesic Udic Argiustolls
Cline-----	Fine, mixed, mesic Udorthentic Haplustolls
Crete-----	Fine, montmorillonitic, mesic Pachic Argiustolls
Eudora-----	Coarse-silty, mixed, mesic Fluventic Hapludolls
Florence-----	Clayey-skeletal, montmorillonitic, mesic Udic Argiustolls
Geary-----	Fine-silty, mixed, mesic Udic Argiustolls
Haynie-----	Coarse-silty, mixed (calcareous), mesic Mollic Udifluvents
Hobbs-----	Fine-silty, mixed, nonacid, mesic Mollic Ustifluvents
Holder-----	Fine-silty, mixed, mesic Udic Argiustolls
Irwin-----	Fine, mixed, mesic Pachic Argiustolls
Kahola-----	Fine-silty, mixed, mesic Cumulic Hapludolls
Konza-----	Fine, montmorillonitic, mesic Udertic Paleustolls
Ladysmith-----	Fine, montmorillonitic, mesic Pachic Argiustolls
Longford-----	Fine, montmorillonitic, mesic Udic Argiustolls
McCook-----	Coarse-silty, mixed, mesic Fluventic Haplustolls
Muir-----	Fine-silty, mixed, mesic Cumulic Haplustolls
Ortello-----	Coarse-loamy, mixed, mesic Udic Haplustolls
Orthents-----	Orthents
Reading-----	Fine-silty, mixed, mesic Typic Argiudolls
Sarpy-----	Mixed, mesic Typic Udipsamments
Smokyhill-----	Clayey over loamy, mixed, mesic Cumulic Haplustolls
Sogn-----	Loamy, mixed, mesic Lithic Haplustolls
Solomon-----	Fine, montmorillonitic (calcareous), mesic Vertic Haplaquolls
Sutphen-----	Fine, montmorillonitic, mesic Udertic Haplustolls
Tully-----	Fine, mixed, mesic Pachic Argiustolls
Valentine-----	Mixed, mesic Typic Ustipsamments
Wells-----	Fine-loamy, mixed, mesic Udic Argiustolls